

NOTICES OF FINAL RULEMAKING

The Administrative Procedure Act requires the publication of the final rules of the state's agencies. Final rules are those which have appeared in the *Register* 1st as proposed rules and have been through the formal rulemaking process including approval by the Governor's Regulatory Review Council. The Secretary of State shall publish the notice along with the Preamble and the full text in the next available issue of the *Arizona Administrative Register* after the final rules have been submitted for filing and publication.

NOTICE OF FINAL RULEMAKING

TITLE 4. PROFESSIONS AND OCCUPATIONS

CHAPTER 43. BOARD OF OCCUPATIONAL THERAPY EXAMINERS

PREAMBLE

1. Sections Affected
R4-43-204 / Rulemaking Action
Amend
2. The specific authority for the rulemaking, including both the authorized statute (general) and the statutes the rules are implementing (specific):
Authorizing Statute: A.R.S. § 32-3404(A)(4)
Implementing statute: A.R.S. § 32-3426(C)
3. The effective date of the rule:
December 5, 1997.
4. A list of all previous notices appearing in the Register addressing the final rule:
Notice of Rulemaking Docket: 2 A.A.R. 4360, October 25, 1996
Notice of Proposed Rulemaking: 3 A.A.R. 1340, May 23, 1997.
5. The name and address of agency personnel with whom persons may communicate regarding the rulemaking:
Name: Kenneth D. Fink, Executive Director
Address: Arizona Board of Occupational Therapy Examiners
1400 West Washington, Suite 240
Phoenix, Arizona 85007
Telephone: (602) 542-5300
FAX: (602) 542-5469
6. An explanation of the rule, including the agency's reasons for initiating the rule:
 - a. The Board recognizes the importance of continuing education in order to ensure that the General Public continues to receive the safest and most current medical treatment available. Newer and safer methods of treatment are constantly being developed and it is important that the new methods and resources be made available to the patients of Arizona.
 - b. Many of the Board's licensee's have requested that the various types of continuing education categories be broadened to include such training as video tape presentations, provide credit for teaching classes or seminars, writing articles or books, self-study & formal courses of study, etc. This change is expected to greatly increase the availability and selection of continuing educational opportunities for those licensees located in remote areas of Arizona where limited training opportunities exists.
 - c. Recent legislation effective on July 31, 1997, changed the licensing year from a 1 to a 2 year renewal period. The Board increased the continuing education requirement appropriately.
7. A showing of good cause why the rule is necessary to promote a statewide interest if the rule will diminish a previous grant of authority of a political subdivision of this date:
Not applicable.
8. The summary of the economic, small business, and consumer impact:
Small businesses and consumers will benefit from these rule changes because it will broaden the types of training categories and selections and lower costs. Prior to this amendment, training was limited to an "in-class" or student concept. It is anticipated that this change will also help to reduce costs for the consumer by allowing a broader selection of the types of training along with greater scheduling opportunities to suit the trainee as well as the trainer. As an example, the video training industry has helped to improve and lower the cost of medical services training because the source of training is readily available at a much lower cost than formal "in class" training. An additional goal of the change was to encourage occupational therapists to teach their peers in

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classes and seminars by enabling them to claim continuing education credit hours for teaching. Many college professors will tell you that preparing to teach a specific class is a valuable learning experience.

The rule is expected to help reduce the cost to the consumer by helping to reduce continuing education costs to licensees.

9. A description of the changes between the proposed rules, including supplemental notices, and final rules.
- Proposed rule R4-43-204(A) was originally submitted prior to having statutory authority for 2 year licensing. Currently there are licensees that are working under a 1-year license (received prior to the effective date of the enacted legislation) and some licensees are working under a 2-year license. The Board wants the 10 and 6 clock-hour continuing education requirements to continue as they were prior to the 2 year licensing. However, subsequent to July 30, 1997, many licensees will begin working under a 2-year license and therefore, will need to complete 20 or 12 clock-hours of continuing education to complete the same number of hours-per-year as the 1-year licensee. Therefore, R4-43-204(A) was changed to incorporate a 20 and a 12 clock-hour continuing education requirement for the 2-year licensee. That portion of R4-43-204(A) which identified the inclusive period in which continuing education clock-hours shall be completed was removed from subpart R4-43-204(A) and renumbered as R4-43-204(B) in order to make the rule easier to understand.
 - Proposed subpart R4-43-204(B) renumbered to (C).
 - Proposed subpart R4-43-204(C) renumbered to (D) and some of the subparts of subpart R4-43-204(C) were divided into logical subparts and renumbered in order to make the proposed rule easier to read and understand.
10. A summary of the principal comments and the agency response to them.
- The suggestions or recommendations that people submitted for the proposed rulemaking were for the most part things that were already part of the proposed rulemaking or that the Board had the authority to approve. Some of the suggestions concerned the continuing education selection options and the time available for scheduling continuing education. The continuing education options were greatly expanded and include all of the suggested training options except cardiopulmonary resuscitation (CPR) and first aid. The Board decided against allowing CPR and first aid as continuing education options because these are on-going maintenance trainings rather than courses that teach new treatment techniques, improve clinical knowledge, or relate to the occupational therapy profession.
11. Any other matters prescribed by statute that are applicable to the specific agency or to any specific rule or class of rules.
- Not applicable.
12. Incorporations by reference and their location in the rules
- Not applicable.
13. Was the rule previously adopted as an emergency rule?
- No.
14. The full text of the rules follows:

TITLE 4. PROFESSIONS AND OCCUPATIONS

CHAPTER 43. BOARD OF OCCUPATIONAL THERAPY EXAMINERS

Article 2. Licensure

R4-43-204. Continuing Education for Renewal of License

Article 2. Licensure

R4-43-204. Continuing Education for Renewal of License

- A. Pursuant to A.R.S. § 32-3426, the continuing education requirement for renewal of a license is as follows: shall be ten clock-hours per year from date of licensure for the occupational therapist and six clock-hours for the certified occupational therapy assistant.
- Occupational Therapist.
 - 10 clock-hours for renewal of a 1-year license.
 - 20 clock-hours for renewal of a 2-year license.
 - Occupational Therapy Assistant.
 - 6 clock-hours for renewal of a 1-year license.
 - 12 clock-hours for renewal of a 2-year license.
- B. A licensee shall complete continuing education clock-hours during the licensure period immediately prior to the expiration of the license or by the date the licensee's application requesting return to an active license, is received by the Board.
- C. Pursuant to the criteria established in these rules, the subject matter and number of clock-hours for all types of continuing

education programs, courses, and hours are is subject to the approval of the Board.

- D. A licensee may accumulate continuing education clock-hours by participating in education programs that contribute directly to professional competency and relate to the clinical practice of occupational therapy. Continuing education clock-hours may be accumulated by participation in education programs related to occupational therapy services. Those programs may be sponsored by colleges or universities, state or federal licensed health care providers and health professional organizations. Verifiable photo copy(ies) of signed certificates or letters showing the clock-hours in attendance from the educational program sponsor are required as documentation of the licensee's attendance.
- E. A licensee may fulfill continuing education hours by completing any combination of the following activities, if the activity or activities are related to the practice of occupational therapy.
- Participation in a professional workshop, seminar or conference.
 - Self-study or formal study through course work.
 - Viewing a video taped presentation.
 - Successful completion Completion of an undergraduate or graduate course at a college or university shall earn a

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maximum of six clock-hours with submitted proof of a grade of "C" or better and a personal statement describing how the course extends the licensee's professional skill and knowledge relating to the practice of occupational therapy.

5. Publication of an article, book, chapter of a book, film, or video tape. The maximum number of continuing education clock-hours that can be accumulated for each type of publication is:
- a. 10 clock-hours for a book.
 - b. 5 clock-hours for a chapter of a book.
 - c. 4 clock-hours for an article.
 - d. 6 clock-hours for a film or video tape.
- F. To provide proof of completed clock-hours, a licensee shall do 1 or more of the following:
1. Submit the original hours verification sheet displaying the licensee's name and an official stamp beside each class or course, indicating proof of attendance for continuing education sponsored by the American Occupational Therapy Association or Arizona Occupational Therapy Association.
 2. Submit a photo copy of a signed certificate or letter, issued by the sponsoring organization or instructor, showing the clock-hours, date of attendance, name of and information necessary to contact the sponsoring organization and instructor for verification, name of the course or program, and the licensee's name.
 3. Submit a copy of any published article, book, chapter, film or video tape.
- G. A licensee may accumulate a maximum of 4 continuing education clock-hours for a program presented by a licensed occupational therapist or occupational therapy assistant for presentations that are not less than 1 and 1/2 hours in length and are related to the practice of occupational therapy. As

proof of attendance, the licensee shall submit a brochure, agenda, or similar printed document describing the content of the presentation, date, location of the presentation, and names of the presenters, or a signed certificate or letter from the program organizer.

- H. A licensee may accumulate a maximum of 4 continuing education clock-hours for in-service educational training related to clinical occupational therapy services, excluding training for safety, fire evacuation, and cardiopulmonary resuscitation (CPR). As proof of completion, the licensee shall submit a letter from the supervising occupational therapist or other immediate supervisor. The licensee shall submit documentation of:
1. Specific topics.
 2. Presenters.
 3. Dates.
 4. Times.
 5. Location and.
 6. How the training or in-service relates to the clinical practice of occupational therapy and contributes to professional competency.
- I. Substitution of three job-related in-service education clock-hours for one continuing education clock-hour, up to a maximum of three continuing education clock-hours. These substitute clock-hours shall be verified on letterhead by the supervising occupational therapist or other immediate supervisor. The licensee shall submit documentation of:
1. Specific topics.
 2. Presenters.
 3. Dates.
 4. Times.
 5. Location and.
 6. How the training extends the improvement of professional skills in the practice of occupational therapy.

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TITLE 18. ENVIRONMENTAL QUALITY

CHAPTER 2. DEPARTMENT OF ENVIRONMENTAL QUALITY - AIR POLLUTION CONTROL

PREAMBLE

- | | |
|-----------------------------|--------------------------|
| 1. <u>Sections Affected</u> | <u>Rulemaking Action</u> |
| R18-2-333 ✓ | Amend |
| R18-2-901 ✓ | Amend |
| R18-2-1101 ✓ | Amend |
| Appendix 2 ✓ | Amend |
2. The specific authority for the rulemaking, including both the authorizing statute (general) and the statutes the rules are implementing (specific):
Authorizing and implementing statutes: A.R.S. §§ 49-104(A)(11), 49-404(A), and 49-425(A)
3. The effective date of the rules:
December 4, 1997.
4. A list of all previous notices appearing in the Register addressing the final rule:
Notice of Rulemaking Docket Opening: 3 A.A.R. 2177, August 15, 1997
Notice of Proposed Rulemaking: 3 A.A.R. 2142, August 15, 1997

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5. The name and address of agency personnel with whom persons may communicate regarding the rulemaking:

Name: Mark Lewandowski or Martha Seaman, Rule Development Section

Address: ADEQ
3033 North Central
Phoenix, Arizona 85012-2809

Telephone: (602) 207-2230 or (602) 207-2222 (Any extension may be reached in-state by dialing 1-800-234-5677, and asking for that extension.)

Fax: (602) 207-2251

6. An explanation of the rule, including the agency's reasons for initiating the rule:

This rule is the Arizona Department of Environmental Quality's (ADEQ) annual update of its New Source Performance Standards (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAP) incorporations by reference. In addition, this rule includes updates and additions to federal acid rain regulations incorporated by reference.

NSPS/NESHAP regulations. Current regulations incorporated by reference from 40 CFR 60, 61, and 63 are being updated from July 1, 1996, to July 1, 1997. As explained further below, ADEQ has also incorporated new subparts in 40 CFR 63.

Acid Rain. Current regulations incorporated by reference from 40 CFR 72, (core acid rain regulations) have been updated from July 1, 1995, to July 1, 1997. ADEQ has also incorporated by reference 40 CFR 74, 75, and 76 in order to expedite issuance of acid rain permits by the federal deadline of December 31, 1997. (See 40 CFR 72.73(b)) ADEQ proposed to add these parts last year, but at the request of industry commenters, decided to postpone incorporating until the U.S. Environmental Protection Agency (EPA) made corrective revisions to certain portions of 40 CFR 75. These were made by EPA in a direct final rule issued November 20, 1996, at 61 FR 59142. Incorporating these regulations by reference as Arizona regulations will expedite the acid rain permit issuance process. ADEQ is obligated under state and federal law to incorporate federal acid rain requirements in the acid rain permits that it issues (R18-2-306(A)(2); 40 CFR 70.6(a)(1)). The EPA deadline for issuance of Phase II acid rain permits in Arizona is December 31, 1997.

ADEQ's intention in updating these incorporations by reference is to continue to obtain delegated authority from EPA to implement and enforce the NSPS/NESHAP and acid rain programs in Arizona.

A description of each new incorporation by reference follows:

NSPS/NESHAP

Part 63, Subpart U – National Emission Standards for Hazardous Air Pollutant Emissions: Group I Polymers and Resins. [Added at 61 FR 46906; September 5, 1996] This EPA action promulgated NESHAP from existing and new plant sites that emit organic hazardous air pollutants (HAP) identified on the EPA's list of 189 HAP. The regulation covers organic HAP emitted during the manufacture of 1 or more elastomers and which have the potential for reduction by implementation of the standard: styrene, n-hexane, 1,3-butadiene, acrylonitrile, methyl chloride, hydrogen chloride, carbon tetrachloride, chloroprene, and toluene.

Part 63, Subpart DD – National Emission Standards for Hazardous Air Pollutants from Off-Site Waste and Recovery Operations; Subpart OO–National Emission Standards for Tanks–Level 1; Subpart PP–National Emission Standards for Containers; Subpart QQ–National Emission Standards for Surface Impoundments; Subpart RR–National Emission Standards for Individual Drain Systems; Subpart VV–National Emission Standards for Oil-Water Separators and Organic-Water Separators. [Added at 61 FR 34158; July 1, 1996] These NESHAP apply to specific types of facilities determined to be major sources of HAP emissions and that receive certain wastes, used oil, and used solvents from off-site locations for storage, treatment, recovery, or disposal at the facility. The rule requires use of maximum achievable control technology (MACT) to reduce HAP emissions from tanks, surface impoundments, containers, oil-water separators, individual drain systems and other material conveyance systems, process vents, and equipment leaks.

The regulatory text that EPA proposed for the Off-Site Waste and Recovery Operations NESHAP included all of the requirements for the rule in a single subpart DD to be added to 40 CFR part 63. The EPA decided to promulgate the final requirements for the Off-Site Waste and Recovery Operations NESHAP as the above series of 6 new subparts added to 40 CFR part 63.

Part 63, Subpart JJJ – National Emission Standards for Hazardous Air Pollutant Emissions: Group IV Polymers and Resins. [Added at 61 FR 48208; September 12, 1996] This action promulgated national emission standards for hazardous air pollutants (NESHAP) from existing and new plant sites that emit organic hazardous air pollutants (HAP) identified on the EPA's list of 189 HAP. The organic HAP are emitted during the manufacture of 1 or more of the following Group IV polymers and resins: acrylonitrile butadiene styrene resin (ABS), styrene acrylonitrile resin (SAN), methyl methacrylate acrylonitrile butadiene styrene resin (MABS), methyl methacrylate butadiene styrene resin (MBS), polystyrene resin, poly (ethylene terephthalate) resin (PET), and nitrile resin.

ACID RAIN

Part 74 – Sulfur Dioxide Opt-ins. Promulgated by EPA on April 4, 1995, the Opt-in program allows sources not required to participate in the Acid Rain Program the opportunity to participate on a voluntary basis. Combustion sources not otherwise required to reduce SO₂ emissions can opt in and make incremental, low cost reductions, which can then be marketed as allow-

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ances in the national acid rain trading system to sources such as utilities which may not wish to make the reductions or be able to make them at the same cost. Opt-in sources must obtain title V permits. Under recent guidance, a source wishing to opt-in to the program in Arizona may have to apply directly to EPA for an opt-in permit and EPA would issue the opt-in permit, because Part 74 is not incorporated in Arizona regulations. As the general goal of Arizona's acid rain program is to have as much of the implementation as possible take place through the state rather than federal government, incorporation of Part 74 will allow Arizona to work more effectively with potential opt-in sources from the beginning.

Part 75 – Continuous Emission Monitoring. EPA promulgated Part 75, effective January 11, 1993 to ensure compliance with the federal Clean Air Act's Acid Rain Program. EPA received several petitions for review of its January 11, 1993 rule, and promulgated revisions to those rules pursuant to a settlement agreement on May 17, 1995. Initial adverse reaction to the portion of EPA's May 17, 1995 rule dealing with alternative monitoring systems and opacity monitoring for a bypass stack, caused EPA to modify the rule again effective September 7, 1995 and, most recently, on November 20, 1996.

Parts 72, 74 and 76 regularly refer to the methods and procedures in Part 75. ADEQ will be implementing and enforcing the state acid rain program through its Title V permits and believes that implementation of Parts 72, 74 and 76 will be improved with Part 75 as an Arizona regulation. ADEQ has adopted the version of Part 75 that was effective as of July 1, 1997.

Part 76 – Acid Rain Nitrogen Oxides Emission Reduction Program. EPA promulgated Part 76 on March 22, 1994, about 1 week after ADEQ proposed its core acid rain program rule. However, the federal rule, which applied mainly to Phase I acid rain sources, was vacated by a federal court soon thereafter. EPA repromulgated a direct final rule based on the Court's decision and a review of the record effective May 23, 1995. (60 FR 18751) There are no Phase I acid rain sources in Arizona, but ADEQ is now receiving initial Phase II applications. Incorporation of this part facilitates revision of acid rain permits for Phase II NO_x requirements after 1997.

7. A showing of good cause why the rule is necessary to promote a statewide interest if the rule will diminish a previous grant of authority of a political subdivision of this state:

Not applicable.

8. The summary of the economic, small business, and consumer impact:

Identification of Adopted Rulemaking

NSPS/NESHAP/Acid Rain 1997: A.A.C. Title 18; Chapter 2; Articles 3, 9, and 11, Appendix 2

(Please note that the entire Economic, Small Business, and Consumer Impact Statement is included here. No further materials are included in the rulemaking docket.)

Costs

There are no additional costs to the regulated community when a state agency incorporates a federal standard verbatim. The costs of compliance have already occurred, and were considered when the federal regulation was proposed and adopted. These rules impose no additional costs on the regulated community, small businesses, political subdivisions, or members of the public.

Costs to ADEQ are those that may accrue for implementation and enforcement of the new standards. Although there may be some small incremental costs due to this rulemaking, ADEQ does not intend to hire any additional employees to implement or enforce these rules.

Benefits

Benefits accrue to the regulated community when a state agency incorporates a federal regulation in order to become the primary implementer, because the state agency is closer to those being regulated and therefore is generally easier to reach and resolve differences with. ADEQ, in addition to being closer to regulated sources, has a Small Business Assistance Program for air quality issues, which helps greatly in disseminating information and resolving difficulties, compared with leaving jurisdiction with the U.S. EPA, whose regional office is in San Francisco. Local implementation also reduces travel and communication costs.

Health benefits accrue to the general public whenever strong enforcement of environmental laws takes place. Adverse health effects from air pollution result in a number of economic and social consequences, including:

1. Medical costs. These include personal out-of-pocket expenses of the affected individual (or family), plus costs paid by insurance or Medicare, for example.
2. Work loss. This includes lost personal income, plus lost productivity whether the individual is compensated for the time or not. For example, some individuals may perceive no income loss because they receive sick pay, but sick pay is a cost of business and reflects lost productivity.
3. Increased costs for chores and caregiving. These include special caregiving and services that are not reflected in medical costs. These costs may occur because some health effects reduce the affected individual's ability to undertake some or all normal chores, and he or she may require caregiving.
4. Other social and economic costs. These include restrictions on or reduced enjoyment of leisure activities, discomfort or inconvenience, pain and suffering, anxiety about the future, and concern and inconvenience to family members and others.

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Conclusion

In conclusion, the incremental costs associated with this rule are generally low, and apply solely to ADEQ, and the air quality benefits are generally high. In addition, there are benefits to industry from being regulated by a geographically and politically nearer government entity. There are no adverse economic impacts on political subdivisions. There are no adverse economic impacts on private businesses, their revenues or expenditures. Possible employment of new persons has been discussed above, in the context of the impact on state agencies. There are no adverse economic impacts on small businesses, although some regulatory benefits will accrue to them. There are no economic impacts for consumers; benefits to private persons as members of the general public are discussed above in terms of better enforcement. There will be no direct impact on state revenues. There are no other, less costly alternatives for achieving the goals of this rulemaking. The rules are no less stringent and no more stringent than the federal regulations on each subject.

Rule impact reduction on small businesses. A.R.S. § 41-1035 requires ADEQ to reduce the impact of a rule on small businesses by using certain methods when they are legal and feasible in meeting the statutory objectives for the rulemaking. The 5 listed methods are:

1. Establish less stringent compliance or reporting requirements in the rule for small businesses.
2. Establish less stringent schedules or deadlines in the rule for compliance or reporting requirements for small businesses.
3. Consolidate or simplify the rule's compliance or reporting requirements for small businesses.
4. Establish performance standards for small businesses to replace design or operational standards in the rule.
5. Exempt small businesses from any or all requirements of the rule.

The statutory objectives which are the basis of the rulemaking. The general statutory objectives that are the basis of this rulemaking are contained in the statutory authority cited in #2 of this preamble. The specific objectives are as follows:

1. Implement rules necessary for EPA delegation of Clean Air Act § 111 (NSPS) program to Arizona.
2. Implement rules necessary for EPA § 112(I) program delegation to Arizona (NESHAP).
3. Implement rules necessary for acid rain program delegation to ADEQ.

ADEQ has determined that there is a beneficial impact on small businesses in transferring implementation of these rules to ADEQ. In addition, for all 3 of these objectives, ADEQ is required to adopt the federal rules without change. ADEQ therefore finds that it is not legal or feasible to adopt any of the 5 listed methods to reduce the impact of these rules on small businesses. Finally, where federal rules impact small businesses, EPA is required by both the Regulatory Flexibility Act and the Small Business Regulatory Enforcement and Fairness Act to make certain adjustments in its own rulemakings.

9. **A description of the changes between the proposed rules, including supplemental notices, and final rules (if applicable):**

The rules approved by GRRC on December 2, 1997 did not include the change proposed by ADEQ to R18-2-102(3). Difficulties related to the filing and checking of incorporated by reference material under that paragraph prompted GRRC staff to suggest withdrawing the change and ADEQ agreed. ADEQ will consider replacing this blanket incorporation by reference with a specific list in its next incorporation by reference rule making, to be proposed after July 1, 1998.

ADEQ changed "and" to "or" in R18-2-333(C). ADEQ made a number of similar, minor corrections to the incorporation by reference language at R18-2-333(A) and (B), R18-2-901, R18-2-1101(A) and (B) and Appendix 2.

10. **A summary of the principal comments and the agency response to them:**

ADEQ received no comments on this rulemaking.

11. **Any other matters prescribed by statute that are applicable to the specific agency or to any specific rule or class of rules:**

None.

12. **Incorporations by reference and their locations in the rules:**

New Incorporations by reference

Location

40 CFR 74, 75, and 76

R18-2-333(B)

40 CFR 63 (U, DD, OO, PP, QQ, RR, VV, JJJ)

R18-2-1101(B)

Updated Incorporations by reference

Location

40 CFR 72

R18-2-333(A)

40 CFR 60, listed subparts

R18-2-901(A)

40 CFR 61, listed subparts

R18-2-1101(A)

Listed Appendices to 40 CFR Parts 51, 60, 61, 63, and 75, 18 A.A.C. 2, Appendix 2

13. **Was this rule previously adopted as an emergency rule?**

No.

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14. The full text of the rules follows:

TITLE 18. ENVIRONMENTAL QUALITY

**CHAPTER 2. DEPARTMENT OF ENVIRONMENTAL QUALITY -
AIR POLLUTION CONTROL**

ARTICLE 3. PERMITS AND PERMIT REVISIONS

R18-2-333. Acid Rain

**ARTICLE 9. NEW SOURCE PERFORMANCE
STANDARDS**

R18-2-901. Standards of Performance for New Stationary Sources

**ARTICLE 11. FEDERAL HAZARDOUS AIR
POLLUTANTS**

R18-2-1101. National Emission Standards for Hazardous Air Pollutants (NESHAPs)

APPENDIX 2. TEST METHODS AND PROTOCOLS

ARTICLE 3. PERMITS AND PERMIT REVISIONS

R18-2-333. Acid Rain

A. The following subparts of 40 CFR 72, Permits Regulation, and all accompanying appendices, adopted as of July 1, 1995, 1997, (and no future amendments) are incorporated by reference. These standards are on file with the Office of the Secretary of State and with the Department and shall be applied by the Department.

1. Subpart A - Acid Rain Program General Provisions.
2. Subpart B - Designated Representative.
3. Subpart C - Acid Rain Applications.
4. Subpart D - Acid Rain Compliance Plan and Compliance Options.
5. Subpart E - Acid Rain Permit Contents.
6. Subpart F - Federal Acid Rain Permit Issuance Procedures.
7. Subpart G - Acid Rain Phase II Implementation.
8. Subpart H - Permit Revisions.
9. Subpart I - Compliance Certification.

B. 40 CFR 74, 75 and 76 and all accompanying appendices, adopted as of July 1, 1997, (and no future amendments) are incorporated by reference. These standards are on file with the Office of the Secretary of State and the Department and shall be applied by the Department.

BC. When used in 40 CFR 72, 74, 75 or 76, "Permitting Authority" means the Arizona Department of Environmental Quality and "Administrator" means the Administrator of the United States Environmental Protection Agency.

CD. If the provisions or requirements of the regulations incorporated pursuant to in this Section conflict with any of the remaining portions of this Title, the regulations incorporated pursuant to in this Section shall apply and take precedence.

**ARTICLE 9. NEW SOURCE PERFORMANCE
STANDARDS**

R18-2-901. Standards of Performance for New Stationary Sources

Except as provided in R18-2-902 through R18-2-905, the following subparts of 40 CFR 60, New Source Performance Standards (NSPS), and all accompanying appendices, adopted as of July 1, 1996 1997, and no future editions or amendments, are incorporated by reference. These standards are on file with the Office of

the Secretary of State and with the Department and shall be applied by the Department.

1. Subpart A - General Provisions.
2. Subpart D - Fossil-Fuel-Fired Steam Generators for Which Construction is Commenced After August 17, 1971.
3. Subpart Da - Electric Utility Steam Generating Units for Which Construction is Commenced After September 18, 1978.
4. Subpart Db - Industrial-Commercial-Institutional Steam Generating Units.
5. Subpart Dc - Small Industrial-Commercial-Institutional Steam Generating Units.
6. Subpart E - Incinerators.
7. Subpart Ea - Municipal Waste Combustors for which Construction is Commenced after December 20, 1989 and on or before September 20, 1994.
8. Subpart Eb - Municipal Waste Combustors for which Construction is Commenced after September 20, 1994.
9. Subpart F - Portland Cement Plants.
10. Subpart G - Nitric Acid Plants.
11. Subpart H - Sulfuric Acid Plants.
12. Subpart I - Hot Mix Asphalt Facilities.
13. Subpart J - Petroleum Refineries.
14. Subpart K - Storage Vessels for Petroleum Liquids for Which Construction, Reconstruction, or Modification Commenced After June 11, 1973, and Prior to May 19, 1978.
15. Subpart Ka - Storage Vessels for Petroleum Liquids for Which Construction, Reconstruction, or Modification Commenced After May 18, 1978, and Prior to July 23, 1984.
16. Subpart Kb - Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced after July 23, 1984.
17. Subpart L - Secondary Lead Smelters.
18. Subpart M - Secondary Brass and Bronze Ingot Production Plants.
19. Subpart N - Primary Emissions from Basic Oxygen Process Furnaces for Which Construction is Commenced After June 11, 1973.
20. Subpart Na - Secondary Emissions from Basic Oxygen Process Steelmaking Facilities for Which Construction is Commenced After January 20, 1983.
21. Subpart O - Sewage Treatment Plants.
22. Subpart P - Primary Copper Smelters.
23. Subpart Q - Primary Zinc Smelters.
24. Subpart R - Primary Lead Smelters.
25. Subpart S - Primary Aluminum Reduction Plants.
26. Subpart T - Phosphate Fertilizer Industry: Wet-Process Phosphoric Acid Plants.
27. Subpart U - Phosphate Fertilizer Industry: Superphosphoric Acid Plants.
28. Subpart V - Phosphate Fertilizer Industry: Diammonium Phosphate Plants.
29. Subpart W - Phosphate Fertilizer Industry: Triple Superphosphate Plants.

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30. Subpart X - Phosphate Fertilizer Industry: Granular Triple Superphosphate Storage Facilities.
31. Subpart Y - Coal Preparation Plants.
32. Subpart Z - Ferroalloy Production Facilities.
33. Subpart AA - Steel Plants: Electric Arc Furnaces Constructed After October 21, 1974, and On or Before August 17, 1983.
34. Subpart AAa - Steel Plants: Electric Arc Furnaces and Argon-Oxygen Decarburization Vessels Constructed After August 7, 1983.
35. Subpart BB - Kraft Pulp Mills.
36. Subpart CC - Glass Manufacturing Plants.
37. Subpart DD - Grain Elevators.
38. Subpart EE - Surface Coating of Metal Furniture.
39. Subpart GG - Stationary Gas Turbines.
40. Subpart HH - Lime Manufacturing Plants.
41. Subpart KK - Lead-Acid Battery Manufacturing Plants.
42. Subpart LL - Metallic Mineral Processing Plants.
43. Subpart MM - Automobile and Light Duty Truck Surface Coating Operations.
44. Subpart NN - Phosphate Rock Plants.
45. Subpart PP - Ammonium Sulfate Manufacture.
46. Subpart QQ - Graphic Arts Industry: Publication Rotogravure Printing.
47. Subpart RR - Pressure Sensitive Tape and Label Surface Coating Operations.
48. Subpart SS - Industrial Surface Coating: Large Appliances.
49. Subpart TT - Metal Coil Surface Coating.
50. Subpart UU - Asphalt Processing and Asphalt Roofing Manufacture.
51. Subpart VV - Equipment Leaks of VOC in the Synthetic Organic Chemicals Manufacturing Industry.
52. Subpart WW - Beverage Can Surface Coating Industry.
53. Subpart XX - Bulk Gasoline Terminals.
54. Subpart AAA - New Residential Wood Heaters
55. Subpart BBB - Rubber Tire Manufacturing Industry.
56. Subpart DDD - Volatile Organic Compound (VOC) Emissions from the Polymer Manufacturing Industry.
57. Subpart FFF - Flexible Vinyl and Urethane Coating and Printing.
58. Subpart GGG - Equipment Leaks of VOC in Petroleum Refineries.
59. Subpart HHH - Synthetic Fiber Production Facilities.
60. Subpart III - Volatile Organic Compound (VOC) Emissions from the Synthetic Organic Chemical Manufacturing Industry (SOCMI) Air Oxidation Unit Processes.
61. Subpart JJJ - Petroleum Dry Cleaners.
62. Subpart KKK - Equipment Leaks of VOC from Onshore Natural Gas Processing Plants.
63. Subpart LLL - Onshore Natural Gas Processing; SO₂ Emissions.
64. Subpart NNN - Volatile Organic Compound (VOC) Emissions From Synthetic Organic Chemical Manufacturing Industry (SOCMI) Distillation Operations.
65. Subpart OOO - Nonmetallic Mineral Processing Plants.
66. Subpart PPP - Wool Fiberglass Insulation Manufacturing Plants.
67. Subpart QQQ - VOC Emissions From Petroleum Refinery Wastewater Systems.
68. Subpart RRR - Volatile Organic Compound (VOC) Emissions From Synthetic Organic Chemical Manufacturing Industry (SOCMI) Reactor Processes.
69. Subpart SSS - Magnetic Tape Coating Facilities.
70. Subpart TTT - Industrial Surface Coating: Surface Coating of Plastic Parts for Business Machines.
71. Subpart UUU - Calciners and Dryers in Mineral Industries.
72. Subpart VVV - Polymeric Coating of Supporting Substrates Facilities.
73. Subpart WWW - Municipal Solid Waste Landfills.

**ARTICLE 11. FEDERAL HAZARDOUS AIR
POLLUTANTS**

R18-2-1101. National Emission Standards for Hazardous Air Pollutants (NESHAPs)

- A. Except as provided in R18-2-1102, the following subparts of 40 CFR 61, National Emission Standards for Hazardous Air Pollutants (NESHAPs), and all accompanying appendices, adopted as of July 1, 1996 1997, and no future editions or amendments, are incorporated by reference. These standards are on file with the Office of the Secretary of State and with the Department and shall be applied by the Department.
 1. Subpart A - General Provisions.
 2. Subpart C - Beryllium.
 3. Subpart D - Beryllium Rocket Motor Firing.
 4. Subpart E - Mercury.
 5. Subpart F - Vinyl Chloride.
 6. Subpart J - Equipment Leaks (Fugitive Emission Sources) of Benzene.
 7. Subpart L - Benzene Emissions from Coke By-Product Recovery Plants.
 8. Subpart M - Asbestos.
 9. Subpart N - Inorganic Arsenic Emissions from Glass Manufacturing Plants.
 10. Subpart O - Inorganic Arsenic Emissions from Primary Copper Smelters.
 11. Subpart P - Inorganic Arsenic Emissions from Arsenic Trioxide and Metallic Arsenic Production.
 12. Subpart V - Equipment Leaks (Fugitive Emission Sources).
 13. Subpart Y - Benzene Emissions From Benzene Storage Vessels.
 14. Subpart BB - Benzene Emissions from Benzene Transfer Operations.
 15. Subpart FF - Benzene Waste Operations.
- B. Except as provided in R18-2-1102, the following subparts of 40 CFR 63, NESHAPs for Source Categories, and all accompanying appendices, adopted as of July 1, 1996 1997, and no future editions or amendments, are incorporated by reference. These standards are on file with the Office of the Secretary of State and with the Department and shall be applied by the Department.
 1. Subpart A - General Provisions.
 2. Subpart B - Requirements for Control Technology Determinations for Major Sources in Accordance with Clean Air Act Sections 112(g) and 112(j).
 3. Subpart D - Regulations Governing Compliance Extensions for Early Reductions of Hazardous Air Pollutants.
 4. Subpart F - National Emission Standards for Organic Hazardous Air Pollutants from the Synthetic Organic Chemical Manufacturing Industry.
 5. Subpart G - National Emission Standards for Organic Hazardous Air Pollutants from the Synthetic Organic Chemical Manufacturing Industry for Process Vents, Storage Vessels, Transfer Operations, and Wastewater.
 6. Subpart H - National Emission Standards for Organic Hazardous Air Pollutants for Equipment Leaks.

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7. Subpart I - National Emission Standards for Organic Hazardous Air Pollutants for Certain Processes Subject to the Negotiated Regulation for Equipment Leaks.
8. Subpart L - National Emission Standards for Coke Oven Batteries.
9. Subpart M - National Perchloroethylene Air Emission Standards for Dry Cleaning Facilities.
10. Subpart N - Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks.
11. Subpart O - Ethylene Oxide Emissions Standards for Sterilization Facilities.
12. Subpart Q - Industrial Process Cooling Towers.
13. Subpart R - Gasoline Distribution Facilities (Bulk Gasoline Terminals and Pipeline Breakout Stations).
14. Subpart T - Halogenated Solvent Cleaning.
15. Subpart U - National Emission Standards for Hazardous Air Pollutant Emissions: Group I Polymers and Resins.
- ~~16~~16. Subpart W - Epoxy Resins Production and Non-Nylon Polyamides Production.
- ~~17~~17. Subpart X - Secondary Lead Smelting.
- ~~18~~18. Subpart CC - Petroleum Refineries.
19. Subpart DD - National Emission Standards for Hazardous Air Pollutants from Off-Site Waste and Recovery Operations.
- ~~20~~20. Subpart EE - Magnetic Tape Manufacturing Operations.
- ~~21~~21. Subpart GG - Aerospace Manufacturing and Rework Facilities.
- ~~22~~22. Subpart JJ - Wood Furniture Manufacturing Operations.
- ~~23~~23. Subpart KK - Printing and Publishing Industry.
24. Subpart OO - National Emission Standards for Tanks--Level 1.
25. Subpart PP - National Emission Standards for Containers.
26. Subpart QQ - National Emission Standards for Surface Impoundments.
27. Subpart RR - National Emission Standards for Individual Drain Systems.
28. Subpart VV - National Emission Standards for Oil-Water Separators and Organic-Water Separators.
29. Subpart III - National Emission Standards for Hazardous Air Pollutant Emissions: Group IV Polymers and Resins.

Appendix 2. TEST METHODS AND PROTOCOLS

The following test methods and protocols are approved for use as directed by the Department pursuant to under this Chapter. These standards are incorporated by reference as of July 1, 1996 1997 (and no future editions or amendments), except for incorporation dates specifically provided. These standards are on file with the Department and with the Office of the Secretary of State.

1. 40 CFR Part 51, Appendix M.
2. 40 CFR Part 60, all appendices.
3. 40 CFR Part 61, all appendices.
4. 40 CFR Part 63, all appendices.
5. 40 CFR Part 75, all appendices.
6. The Department's "Arizona Testing Manual for Air Pollutant Emissions," (March, 1992).

NOTICE OF FINAL RULEMAKING

/ **TITLE 18. ENVIRONMENTAL QUALITY**

**CHAPTER 7. DEPARTMENT OF ENVIRONMENTAL QUALITY
REMEDIAL ACTION**

PREAMBLE

1. Sections Affected:

R18-7-109 ✓
Article 2
Article 2
R18-7-201 ✓
R18-7-201
R18-7-202 ✓
R18-7-202
R18-7-203 ✓
R18-7-203
R18-7-204 ✓
R18-7-204
R18-7-205 ✓
R18-7-205
R18-7-206 ✓
R18-7-206
R18-7-207 ✓
R18-7-207
R18-7-208 ✓
R18-7-208
R18-7-209 ✓
R18-7-209
Appendix A ✓

Rulemaking Action:

Amend
Repeal
New Article
Repeal
New section
Repeal
New section
Repeal
New section
Repeal
New section
Repeal
New section
Repeal
New section
Repeal
New section
Repeal
New section
Repeal
New section
Repeal

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Appendix A	New appendix
Appendix B ✓	Repeal
Appendix B	New appendix
Appendix C ✓	Repeal
Appendix C	New appendix
Appendix D ✓	Repeal

2. **The specific authority for the rulemaking, including both the authorizing statute (general) and the statutes the rules are implementing (specific):**
Authorizing statute: A.R.S. §§ 49-104(B)(4), 49-104(B)(16), 49-152, Laws 1995, Ch. 151, § 9
Implementing statute: A.R.S. §§ 49-151, 49-152, 49-282.06.
3. **The effective date of the rules:**
December 4, 1997.
4. **A list of all previous notices appearing in the Register addressing the final rule:**
Notice of Emergency Rulemaking: 2 A.A.R. 1465, April 19, 1996
Notice of Docket Opening: 2 A.A.R. 3218, June 21, 1996
Notice of Proposed Rulemaking: 3 A.A.R. 616, February 28, 1997
Notice of Public Information: 3 A.A.R. 1224, May 2, 1997
5. **The name and address of agency personnel with whom persons may communicate regarding the rule:**
Name: Katheryn A. Cross
Address: 3033 North Central Avenue #824
Phoenix, Arizona 85012-2809
Telephone: (602) 207-2222 or (800) 234-5677, ext. 2222
(Arizona only)
Fax: (602) 207-2251
This document can be downloaded on ADEQ's web site at <http://www.adeq.state.az.us/admin/do/rules.htm>.
6. **An explanation of the rule, including the agency's reasons for initiating the rule:**

A. Final Soil Remediation Standards Rule

Purpose of the Rule

The purpose of this rule is to establish Department-wide risk-based standards applicable to soil remediation activities. Current A.R.S. Title 49 statutes and rules require contaminated soil to be cleaned up (or remediated). This rule answers the question of "how clean is clean" across all departmental soil cleanup programs. Generally speaking, soil which meets the remediation standards described in the rule is "clean enough". The Soil Remediation Standards Rule replaces a practice of establishing cleanup standards on a program-by-program, and often site-by-site, basis.

This rule is based on the idea of "risk-based remediation" which means that cleanup levels relate to the risk to human health and the environment posed by contaminated soil. Risk-based remediation should result in greater cost effectiveness by better matching expenditures to the contaminated site posing the greatest amount of risk. This rule only applies to contaminated soil, and it will not apply retroactively.

A.R.S. § 49-152(A) sets forth a 2-step process to be used in promulgating soil remediation standards: interim and final standards. Today's rule, which contains final standards, completes that 2nd step.

Background of the Rule

Before the Interim Soil Remediation Standards Rule (Interim Rule) became effective, no 1 set of standards applied across all Departmental soil cleanup programs. The standards that did exist often required cleanup to background levels or to a level that is not detectable by analytical methods. These standards were in many cases difficult to achieve and did not always relate to the risk to human health and the environment posed by the contamination.

Historically, a person remediating contaminated property under a program administered by the Department had to take several steps before actual cleanup activities could begin. First, the cleanup standards themselves had to be determined. This determination frequently took the form of discussions and site-by-site negotiations between the Department and the remediating party. The length of time needed to determine cleanup standards could be brief, or lengthy, depending on the remediation site in question. Even after the actual cleanup efforts were completed under 1 program, it was possible that the cleanup requirements of a 2nd, or a 3rd Departmental program also applied to the site in question. Additional program requirements would then be imposed, and the process of determining the cleanup standards under the 2nd or 3rd program would begin.

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The regulated community and the Department both realized that this approach was time consuming, yielded inconsistent results, and led to shopping for the "best" remediation program. The Department responded to this situation by convening the Cleanup Standards/Policy Task Force (Task Force) in September, 1994. The Task Force is a collaborative effort of the business community, the interested public, and the regulators themselves to develop risk-based remediation standards applicable to remediations conducted throughout the Department. The Task Force members are listed as follows, along with the organization they represented. Pete Allard (*Arizona Association of Industries*); Sally Bender (*Arizona Counties*); Teri Copeland (*Arizona Association of Industries*); Pat Cunningham (*Office of the Attorney General*); Ethel DeMarr (*ADEQ*); Roger Ferland (*Arizona Association of Industries*); Karen Gaylord (*Arizona League of Cities & Towns*); Chuck Graf (*ADEQ*); Norm Gumenik (*ADEQ*); Will Humble (*Arizona Department of Health Services*); Dave Kimball (*Arizona Chamber of Commerce*); Tom Kirk (*Valley Partnership*); Kim Kobriger (*Norwest Banks*); Pat Kuefler (*ADEQ*); Jeff Kulon (*ADEQ*); Jim Lemmon (*General Public*); Anthony Leverock (*ADEQ*); Doug McAllister (*Arizona Chamber of Commerce*); Alvin Mushkatel (*Arizona State University*); Michele Robertson (*ADEQ*); Kathy Roediger (*General Public*); Mark Santana (*ADEQ*); Clyde Wheeler (*Gateway Coalition/General Public*); Greg Witherspoon (*SRP*). A complete listing of the Task Force participants can be found in the 1st document provided in section F. The recommendations of the Task Force were the basis for the enactment of the Soil Remediation Statute (A.R.S. §§ 49-151 and 49-152), which was passed into law in June 1995.

Due to the complexity of developing the risk-based standards and the desire of the legislature to establish uniform remediation levels quickly, the Department was directed to promulgate soil remediation standards in 2 steps. First, the Department was required to promulgate an emergency rule to adopt the Health-Based Guidance Levels (HBGLs) developed by the Arizona Department of Health Services (ADHS) as residential cleanup standards and develop risk assessment guidance. The HBGLs, which were initially developed to be used as a screening tool at ADEQ, were based solely on the ingestion of contaminated soil under a residential exposure scenario. In addition, the Department was mandated to develop a total petroleum hydrocarbon (TPH) standard and non-residential HBGLs. Second, the Department was directed to promulgate permanent risk-based standards through normal rulemaking.

The Department, working with the Task Force, developed the Interim Rule. The Interim Rule was promulgated as an emergency rule, as required by statute, but included notice to the public and provided an opportunity for public comment. The Interim Rule became effective on March 29, 1996, and by the terms of the statute, will govern until the Final Rule becomes effective.

The Department has continued to work with the Task Force to develop the Final Soil Remediation Standards Rule (Final Rule). In addition to the Task Force meetings, the Department has arranged smaller "stakeholder meetings" to discuss and resolve specific technical issues regarding the Final Rule. The Task Force reached consensus on a number of issues. There was general consensus among the Task Force that permanent pre-determined standards should evaluate more than just the ingestion exposure route incorporated in the HBGLs. Specifically, the Task Force wanted the final pre-determined standards to take into account the risks posed by inhalation. The Task Force weighed a number of options proposed by ADHS, but was unable to reach consensus on the methodology for final pre-determined risk-based remediation standards. Following presentations on the positions of Task Force members, the decision was deferred to the Director of ADEQ.

In addition to reviewing recommendations from Task Force members (including ADHS), the Director convened several meetings with outside health experts not previously involved in the process. The Director decided that the final pre-determined risk-based remediation standards would: 1) utilize United States Environmental Protection Agency (USEPA) Region IX Preliminary Remediation Goals (PRGs) methodology; 2) include ingestion, inhalation and dermal contact exposure routes; 3) use an excess lifetime cancer risk of 1×10^{-6} for Class A (known human) carcinogens and 1×10^{-5} for Class B and C carcinogens; and 4) use a Hazard Quotient no greater than 1 for contaminants that cause non-cancer health effects. The Director's decision represents an effort to balance the public's concerns about potential exposure to known cancer-causing contaminants with the need to encourage the regulated community to undertake cleanups.

The Final Rule was proposed on February 7, 1997. A.R.S. § 49-1023(B) mandates that an agency must provide persons the opportunity to submit oral or written comments for at least 30 days after publication of the notice of proposed rulemaking. The original formal comment period ran from February 28, 1997, to April 4, 1997.

Concerns were raised by stakeholders that there was inadequate time to evaluate potential impacts of the rule. In particular, biosolids generators and applicators were concerned that there would be reduced demand for biosolids as a result of the rule. In response to these concerns, the Department extended the public comment period another 35 days and scheduled a public meeting to address these concerns. In total, the formal comment period ran for 70 days.

Throughout the process of developing the Interim and Final Rules, the Department has been collaborating with the Task Force. In September of 1996, the Department made a presentation to the Task Force outlining features of the proposed rule. In January of 1997, the Department mailed a copy of the draft proposed rule to each person who attended Task Force meetings and requested informal feedback prior to formal proposal in February, 1997.

The Final Rule was adopted by the Department on September 18, 1997, and was heard by the Governor's Regulatory Review Council (GRRC) on November 4, 1997. Following discussion at the GRRC hearing, the rule was tabled until the December 2, 1997, GRRC meeting. GRRC requested that ADEQ evaluate comments received at the meeting on 3 issues: 1) The polychlorinated biphenyl SRL; 2) The use of 1×10^{-6} as the point of departure for determining cumulative site-specific carcinogenic risk levels; and 3) Ecological risk. As a result, the Department held a Task Force meeting to discuss the issues. Changes made to the rule since adoption are discussed in section D below and in section # 10.

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B. Statutory Objectives of the Enabling Legislation A.R.S. §§ 49-151 and 49-152

A.R.S. §§ 49-151 and 49-152 require the Department to establish risk-based standards for remediation of contaminated soil. Responsible parties, operators or owners of property containing contaminated soil are affected by the statutes. There is no independent requirement in A.R.S. §§ 49-151 or 49-152 for a party to remediate; the duty to clean up is imposed by 1 of the existing A.R.S. Title 49 remediation programs. Sites which meet the Final Soil Remediation Standards are considered "clean enough."

A.R.S. §§ 49-151 and 49-152 direct the Department to promulgate soil remediation rules that:

1. Set forth remediation standards that protect human health and the environment and are consistent with applicable environmental statutes and with A.R.S. § 33-434.01. This includes establishing pre-determined risk-based standards based on residential and non-residential exposure assumptions, and issuing guidance on methods for calculating case-by-case, site-specific remediation levels based on a risk assessment.
2. Require the owner of remediated property to provide notice, in the form of a Voluntary Environmental Mitigation Use Restriction (VEMUR) filed with the appropriate county recorder, if the property has been remediated to non-residential standards. Provide for the cancellation of a VEMUR when certain statutory conditions are met.
3. Establish a Departmental Repository that lists sites remediated under programs administered by the Department under A.R.S. Title 49.

C. Overview of the Final Soil Remediation Standards Rule

The Final Rule does not require soil remediation; it provides the standards which must be met in order to successfully complete remediation. The requirement to perform soil remediation is found in the specific A.R.S. Title 49 statutes for the Water Quality Assurance Revolving Fund (WQARF) Program; the Underground Storage Tank Program; the Hazardous Waste Management Program; the Solid Waste Management Program; the Special Waste Management Program; and the Aquifer Protection Permit Program. Additionally, the remediation standards apply to parties who voluntarily conduct soil remediation for the Greenfields Pilot Program, the Voluntary Remediation Program and the WQARF Voluntary Program. The appropriate regulatory program, not the Final Rule, will determine which contaminants require remediation based on the nature of the release or other regulated activity. Once the contaminant has been identified, the Final Rule establishes the level to which the contaminant must be remediated. Some key features of the Final Rule include the following:

Applicability

There are 3 categories of persons who undertake remediation activities. The 1st category includes persons who have a legal duty to remediate under the Department's statutory authority (A.R.S. Title 49) and who are correcting contamination before any enforcement action is taken by the Department. Persons required to remediate contaminated soils under A.R.S. Title 49 authorities may be eligible to conduct their remediations under 1 of the Department's voluntary programs.

A 2nd category includes persons who are conducting remediation activities pursuant to an enforcement action issued by the Department under A.R.S. Title 49. Enforcement actions include consent orders, compliance orders, and civil and criminal litigation. Persons in this category have the same legal duty to remediate as those described above, but are not eligible to conduct remediations under 1 of the Department's voluntary programs.

The 3rd category consists of persons conducting remediation outside the Department's jurisdiction. The Department recognizes that it has no regulatory authority over a person who is either remediating a site which has not been so contaminated as to violate state law under A.R.S. Title 49, or a person who is not legally responsible for correcting the contamination under A.R.S. Title 49. A person in this category is a "volunteer" in the strictest sense of the word. As noted above, the Final Rule does not create any new regulatory authority to require remediation and does not affect the actions of these volunteers. However, the Department is aware of many instances where a person who is not a responsible party wishes to conduct remediation in preparation for a change in property use or sale, and requests a letter to facilitate that transaction. Even though there is no legal obligation to remediate, a person may request a letter from the Department indicating whether the property has met the soil remediation standards. If these persons perform soil remediation activities under 1 of the Department's voluntary programs, the requirements of this Article must be met. However, if a person is outside the Department's regulatory jurisdiction and no letter from the Department is requested, remediation may be conducted without the Department's involvement or knowledge.

Effective Date

The Department believes that the determination of whether the Interim or the Final Soil Remediation Standards Rule applies should be based on whether the site has been adequately characterized. Transitions for remediations in progress are frequently a difficult issue. The Department has balanced fairness issues with the ability to clearly identify remediation stages that fall under the new Final Rule. The Interim Rule will continue to apply to a person remediating a site that has been completely characterized before the Final Rule becomes effective. If a person has completely characterized the site prior to the effective date of the Final Rule, the Department feels that it is inappropriate to require additional characterization to a new standard. The term "characterized" is defined in the rule to mean that laboratory analytical results delineating the full extent of soil contamination have been received by the person conducting the remediation. Although a remediating party may not be required to obtain the program's concurrence whether the site has been characterized, the party should be confident that the site has been adequately characterized before the effective date of the Final Rule if they desire to complete the remediation under the Interim Rule. This is especially true if the remediating party will be requesting a Letter of Completion. It should be noted that the Department strongly recommends obtaining concurrence from the Department regarding characterization in order to minimize the potential

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of conducting additional sampling at a later time. In addition to establishing a clear transition date for applicability of the Final Rule, the Department also believes that remediating parties should be given the choice to remediate under the Final Rule if the new standards under the Final Rule are less stringent than the standards under the Interim Rule.

Approaches For Determining the Soil Remediation Level

The Final Rule allows persons conducting soil remediations to select from 3 different approaches for determining the appropriate soil remediation level. The 1st approach allows the use of "off-the-shelf" or "1-size-fits-all" remediation levels, called Soil Remediation Levels (SRLs). The SRLs are pre-determined standards which correspond to a fixed level of risk to human health posed by contaminated soil and include additional factors not considered in the HBGLs. The SRLs were calculated by ADHS largely using the USEPA Region IX PRG guidance. The PRG guidance utilizes the most current USEPA toxicological and risk assessment information and considers inhalation (breathing), ingestion (eating), and dermal (contact with skin) routes of exposure for contaminated soil. The risk-based levels combine current USEPA toxicity values with standard exposure factors to estimate contaminant concentrations in soil that are protective of humans, including sensitive groups, over a lifetime. More information on the standard exposure factors can be found in the 2nd document provided in section F.

The 2nd approach is a "customized" approach which allows a person to develop site-specific cleanup levels determined from a risk assessment. In evaluating the risk to human health, a risk assessment takes into consideration the concentration of a contaminant, the health effects of the contaminant, and the potential for people to come into contact with the contaminant. Allowing the use of a risk assessment gives the remediating party the opportunity to develop alternative remediation levels which are specific to the site, but still protective of human health.

The site-specific remediation levels may be achieved through the use of institutional or engineering controls. A legal restriction on the use of the property would be an example of an institutional control. An example of an engineering control is the creation of a physical barrier, such as an asphalt surface, that prevents direct contact with the contamination. However, if such a control is used to meet the site-specific remediation level, the Final Rule requires a legal mechanism to ensure that the control will be maintained. For example, under the Hazardous Waste Management Program, a Post-Closure Permit would be an effective means of ensuring the maintenance of an engineering control.

In order to use either the SRLs or site-specific remediation levels determined from a risk assessment, several conditions must also be met. Any contaminants in the soil remaining after remediation cannot: 1) Contaminate or threaten to contaminate groundwater or surface water; 2) Exhibit a hazardous waste characteristic of ignitability, corrosivity or reactivity; or 3) Cause or threaten to cause an adverse impact to ecological receptors. This 3rd condition is described in more detail below. The Department retains its authority to take action in the case of soil contamination that causes a nuisance or poses an imminent and substantial endangerment to public health or the environment.

A 3rd approach for determining a cleanup level allows a site to be cleaned up to a level consistent with naturally occurring contaminants in the soil. This approach is called "cleaning up to background," and like the "customized" approach, is based on site-specific information. When cleaning up to background, a person must demonstrate that the background concentration for the contaminant of concern is appropriate and justifiable. The Department considers a proper demonstration to be 1 which uses site-specific information on the history of land use at the site, laboratory analytical results from sampling of soils unaffected by a release, and a statistical analysis of the soil sample results. Background concentrations are not based on anthropogenic, or human caused, contamination.

Residential and Non-Residential Standards

The Final Rule provides flexibility for the remediating party to select a remediation standard that is protective of human health and the environment while also allowing the standard to be appropriate for the use of the property. For instance, industrial properties are no longer required to remediate to levels that would be protective of children living on the site if there is no potential for residential use. The party conducting the remediation can decide to remediate to the more protective residential standards or the less protective non-residential standards, depending on how the property will be used. However, the property must be remediated to residential standards if the land use at the time remediation is complete is residential, as defined by statute.

If a person remediates to a non-residential level, a Voluntary Environmental Mitigation Use Restriction (VEMUR) must be filed with the county recorder in the county where the property is located. The VEMUR provides notice that the property has not been cleaned up to a level protective of residential use and that the property owner agrees to limit the property to non-residential use. A Department official signs the VEMUR form verifying that the non-residential standards have been achieved at the property. The party conducting the remediation must provide the appropriate information to the applicable Departmental program for evaluation.

The choice of remediation standards facilitates property transfers by providing predictable and protective standards based on the probable use of the property. The Department will be developing guidance to assist owners in understanding which property uses should be considered residential. This guidance, along with the notification information, will also provide buyers and lenders with the necessary information to make decisions.

Notice of Remediation

The Task Force expressed concerns that the Departmental Repository must contain information about proposed and ongoing remediations in order to be of real value. This is due to considerable lengths of time that remediation activities can take to complete. Therefore, the rule requires parties to submit a Notice of Remediation prior to conducting a soil remediation. The Notice

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will be entered into the Repository. The Notice of Remediation contains: a description of the remediation project; the current and post-remediation property use; the rationale for the selection of remediation levels; and the proposed remediation technologies.

Letter of Completion

The Final Rule provides a process for a remediating party to obtain a Letter of Completion from the Department verifying that the soil remediation standards have been achieved. If a remediating party requests a Letter of Completion, they must submit a minimum amount of information for the Department to make this evaluation. The individual Departmental programs will evaluate the information submitted to verify whether the soil remediation standards have been met and issue a Letter of Completion or request additional information to make the verification.

The Letter of Completion addresses the adequacy of the soil remediation, it is not meant to "close out" a site from program requirements. It confirms that for those contaminants identified, remediation to acceptable levels has been achieved. Of course, a program may close out a site based on the program's requirements and this may include a Letter of Completion.

D. Executive Summary of the Concise Explanatory Statement

This section describes the major changes between the proposed rule and the final rule. A detailed description of these issues as well as a discussion of other issues can be found in section #10, which describes comments received and the Department's response. Section #10 also describes changes made in response to comments received at the November 4, 1997, GRRC hearing.

SRLs

In response to comments received, the Department developed alternative SRLs for arsenic and adjusted the hydrocarbon SRLs. In addition, the depth limits were not adopted. These issues are discussed in more detail in the following sections.

1. Arsenic SRLs

When the Final Rule was proposed, there were many comments that the proposed arsenic SRLs were unrealistically low compared to naturally occurring arsenic concentrations. Although the Department recognized the proposed SRLs were stringent, the majority of persons performing remediations on sites where arsenic was a contaminant of concern were anticipated to opt for the background level approach. However, this approach would require many persons to demonstrate that the level of arsenic in the soil was a naturally occurring background concentration.

Additionally, the proposed arsenic SRLs were seen as conflicting with federal and state regulations governing the land application of biosolids (R18-13-1505) which allow significantly higher concentrations of arsenic to be present in the biosolids. As a result, arsenic concentrations in soils where biosolids are applied potentially could exceed the proposed SRLs for arsenic, especially the residential SRL. There was concern that the proposed SRLs would limit the land application of biosolids and create disposal problems for generators of biosolids that were intended to be alleviated by the biosolids rule.

As a result of the problems associated with the natural background levels of arsenic, the potential for adverse impacts on the biosolids program, as well as USEPA's current re-evaluation of the arsenic slope factor, the Department has adopted modified arsenic SRLs in the Final Rule. The residential and non-residential arsenic SRLs are 10 mg/kg based on the average naturally occurring background concentration of arsenic in Arizona soils. The average background concentration is obtained from sampling data reported by the United States Geological Survey (USGS). Only 1 concentration for both exposure scenarios is adopted because natural background would not vary based on land use. Although the arsenic SRLs have been modified, a party is still free to demonstrate that arsenic present at the site is representative of background levels, and remediate to that level.

2. Hydrocarbon SRLs

Soils contaminated with petroleum substances often contain hundreds of different hydrocarbons. This presents an obstacle in developing risk-based SRLs for hydrocarbon mixtures due to the variability in constituents at contaminated sites and the differing toxicity and carcinogenic potential among hydrocarbons. In order to develop SRLs for hydrocarbons, the Department made an assumption that the gasoline range of hydrocarbons, up to C₁₀, is represented by the individual hydrocarbons that have available toxicity information and calculated SRLs. These hydrocarbons include benzene, toluene, ethylbenzene, and xylene. Therefore, it was necessary to establish a standard for hydrocarbons with more than 10 carbon atoms. Due to the fact that diesel fuel contains hydrocarbons which predominantly span a carbon number range of C₉ to C₂₂, the decision was made to develop SRLs for a range of hydrocarbons similar in content to diesel fuel.

Lifetime dermal studies for Diesel Fuel No. 2 analyzed and evaluated by Millner et. al. in *Human-Based Soil Cleanup Guidelines for Diesel Fuel No. 2* (Journal of Soil Contamination, 1992) were selected as the basis for deriving a cancer slope for hydrocarbons. The cancer slope factor used in developing the hydrocarbon SRLs is the geometric mean of the 95% upper confidence limit of cancer potency factors derived from 21 toxicological studies of diesel fuel mixtures. Since there are no studies that have established diesel fuel as a known human carcinogen, the SRLs are calculated using a target cancer risk of 1×10^{-5} . Exposure assumptions for calculating these SRLs are identical to those used for non-volatile organic compounds.

When the Department proposed the new hydrocarbon SRL, it was identified as "Hydrocarbons C₉"); It was anticipated that a new analytical method would be required and the Department requested ADHS to develop that method. In cooperation with other environmental laboratories, ADHS developed Method 8015AZ to quantitate the designated range of hydrocarbons. ADEQ

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was informed that C₃₂ is a reasonable limit of quantitation for this method and that the range from C₉ to C₁₀ would require additional analysis. As a result, the hydrocarbon SRL listed in Appendix A is now designated as "Hydrocarbons C₁₀ to C₃₂." The hydrocarbon SRLs are conservative for those hydrocarbons within the range of C₂₂ to C₃₂ that are less toxic. Hydrocarbons with more than 32 carbon atoms are not included in the SRL. However, any individual toxic constituents, such as PAHs, must be remediated to the individual SRL.

In summary, if an individual SRL has been determined for a hydrocarbon (for example, benzo(a)pyrene), the individual SRL must be used. The individual SRLs also apply to any hydrocarbons that have less than 10 carbon atoms. This means that a gasoline release must be remediated to the individual SRLs for BTEX. Since the cancer slope factor used to derive the SRLs is applicable to diesel range hydrocarbons, the SRL may be applied only to hydrocarbons without individual SRLs that contain between 10 and 32 carbon atoms.

3. Polychlorinated Biphenyls (PCBs) SRLs

The proposed rule provided an option to allow PCB cleanups subject to the Toxic Substances Control Act (TSCA) to meet the cleanup standards in federal regulations at 40 CFR 761(G). The Department deleted the option in the adopted rule because it was unnecessary; this rulemaking applies only to soil remediations conducted under A.R.S. Title 49. Additionally, a Letter of Completion cannot be issued for TSCA-regulated PCB cleanups because the Department cannot provide assurance that the USEPA will accept the cleanup as meeting all of their requirements. At the GRRC hearing, commenters argued that the deletion of this option limited the ability of TSCA-regulated parties to remediate soil to the TSCA PCB cleanup standards. Although the Department does not believe the provision is necessary, the proposed rule language referring to TSCA PCB cleanup standards for TSCA-regulated spills has been reinserted into the rule to remove any unintended consequences that may have resulted from the deletion. However, the Department amended the original language to clarify that a Letter of Completion cannot be issued by the Department for cleanups that attain TSCA standards.

At the GRRC hearing, commenters also argued that the PCB SRLs were more stringent than federal standards and should be changed to 10 mg/kg for residential use and 25 mg/kg for non-residential use to be consistent with federal requirements. Subsequent to the GRRC hearing, the Department was advised by the Task Force that the USEPA Integrated Risk Information System (IRIS) contains updated cancer slope factors for PCBs and requested that the PCB SRLs be recalculated using the new data. It should be noted that the PCB cleanup requirements under TSCA do not equate to the pre-determined standards (SRLs) in this rule. In fact, TSCA sets cleanup requirements for limited authorized activities based on all of the following factors: the concentration of PCBs in the spilled material, the volume of the spill, the date of the spill, 3 property use designations, and the use of property adjacent to the spill location. Additionally, TSCA excludes a number of spill situations from application of the TSCA standards. Because these limitations in TSCA are not available under the state rule, the Department did not revise the standards as proposed at the GRRC hearing. However, the Department has revised the PCB SRLs in Appendix A to reflect the most recent toxicological data available from the USEPA. The calculation methodology used to derive the SRLs and the carcinogenic risk posed by the new PCB SRLs have not changed. The new PCB SRLs are 2.5 mg/kg for residential use and 13 mg/kg for non-residential.

4. Depth Limits for SRLs

Some members of the Task Force expressed an interest in establishing a depth limit for pre-determined standards where remediation activities would not be required beyond a specified depth. Prior to rule proposal, several stakeholder meetings were held to discuss this issue but no consensus could be reached. To solicit comments on depth limits in the proposed rule, the Department offered 2 options with the stipulation that only 1, or a variation of 1, would be selected for adoption in the Final Rule. Option 1 set a depth limit for non-volatile contaminants at 4 meters (approximately thirteen feet) below ground surface. Selection of Option 1 would have required a person to remediate to the SRLs only to a depth of 4 meters below ground surface for non-volatiles as long as groundwater quality was protected. Volatile contaminants would be remediated to the SRLs for the full lateral and vertical extent of the contamination as currently required under the Interim Rule. Four meters was selected as the limit for non-volatiles because excavations for swimming pools and basements could result in contact with contaminated soil if the excavated soil was used in landscaping.

Option 2 also set a depth limit for non-volatile contaminants at 4 meters below ground surface, but added a depth limit for volatile contaminants at 6 meters (approximately 20 feet) below ground surface. As with non-volatile contaminants, a person would still have to demonstrate that groundwater would not be impacted. The 6 meter depth was selected based on comments received.

Comments received during the public comment period indicated no consensus of opinion on adopting depth limits. Persons with responsibility for urban land use expressed extreme concern that there would be no notice of the contamination at depth to subsequent purchasers of the property. Additionally, commenters expressed concern that there was no scientific justification that the depth limit for volatiles would provide adequate protectiveness. Although the Department acknowledges that the depth limits for SRLs may provide adequate protection in some exposure scenarios, the limits could not be guaranteed to be protective for others. As a result of the lack of consensus and the inability to provide adequate notice, neither depth limit is adopted at this time. One of the few views shared by both proponents and opponents of the depth limits was that a site-specific risk assessment is the most appropriate means of determining a depth limit.

Risk assessment guidance is being developed to assist in the preparation of risk assessments, both deterministic and probabilistic. The deterministic guidance will include a methodology fashioned after the American Society for Testing Material's (ASTM) Risk-Based Corrective Action Tier 2 for a fast, efficient risk assessment. Using default exposure assumptions, this risk assess-

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ment can be performed to exclude exposure pathways, modify soil characteristics, or adapt to site-specific conditions. This approach will allow a person to conduct a limited risk assessment without having to do a full risk assessment to make a depth limit determination.

Site-Specific Remediation Levels

In the proposed rule, the Department defined the residential site-specific remediation level as contamination that resulted in an excess lifetime cancer risk of 1×10^{-6} for Class A carcinogens and 1×10^{-5} for Class B and C carcinogens and a hazard index no greater than 1 without the use of institutional or engineering controls. A number of comments were received stating that the limitation on risk did not take into account total site risk and were not authorized by the statute. Other comments stated that the statute does not prohibit the use of any remediation method to achieve the site-specific remediation levels. The Department agrees that it is inappropriate to require evaluation based on the category of the carcinogen in determining cumulative site risk. In addition, the Department agrees that institutional and engineering controls can be used to meet the site-specific remediation levels. Therefore, the definition of residential site-specific remediation level in the Final Rule has been revised.

Under the Final Rule, the remediation levels derived from a risk assessment using either residential or non-residential exposure assumptions may not exceed a cumulative excess lifetime cancer risk between 1×10^{-6} and 1×10^{-4} and a Hazard Index of 1. The rule requires the use of 1×10^{-6} as the point of departure for determining the appropriate carcinogenic risk and allows site-specific factors to be used to move towards the least protective risk allowable, 1×10^{-4} . This means that the risk will be assumed to be 1×10^{-6} unless site-specific factors indicate that a different risk within the range of 1×10^{-6} and 1×10^{-4} is more appropriate. The factors include: the presence of multiple contaminants; the existence of multiple pathways of exposure; the uncertainty of exposure; and the particular sensitivity of the exposed population. For cleanups under the WQARF Program, consideration of other factors, such as cost effectiveness and technical feasibility, may also be useful in justifying departure from 1×10^{-6} .

At the GRRC meeting, commenters argued that the use of 1×10^{-6} as the point of departure for determining site-specific carcinogenic risk levels in R18-7-206(E) should be deleted. They stated that the point of departure creates a presumption that 1×10^{-6} is the appropriate carcinogenic risk level. Subsequent to the GRRC meeting, the Department was advised by the Task Force that the use of 1×10^{-6} as the "point of departure" is more appropriately addressed in guidance as long as ADEQ retains the authority to insist on carcinogenic risk levels at 1×10^{-5} or 1×10^{-6} for both residential and non-residential cleanups depending upon site-specific conditions. As a result, the Department deleted the "point of departure" language from the rule, but added language which makes it clear that the remediating party and ADEQ shall select the excess lifetime cancer risk between 1×10^{-6} to 1×10^{-4} based upon site-specific factors.

Background Levels

The proposed Final Rule included the background remediation standard in R18-7-205, Site-Specific Remediation Standards. Comments indicated that some confusion was generated by the designation of the background standard as a site-specific remediation standard. Therefore, the Final Rule establishes the background remediation standards in a separate section of the rule, R18-7-203. Nevertheless, a background concentration must be demonstrated separately at each site.

Ecological Risk

A.R.S. § 49-152(A) mandates the establishment of soil remediation standards which are protective of human health and the environment. In order to fulfill this "environment" mandate, the Department proposed a condition that any remaining contaminants at a remediated site may not cause an adverse impact to ecological receptors. Three criteria were listed in order to determine the potential for adverse impacts: 1) there must be an ecological receptor and the site evaluated must be at least 1 acre; 2) the contaminant must be able to bioaccumulate; and 3) there must be a pathway for the contaminant to reach the receptor. The proposed language intended that a site would have to meet all 3 criteria to require either: 1) mitigation of impacts by means of further remediation or elimination of the exposure pathway; or 2) the performance of an ecological risk assessment to evaluate the risk to the ecological receptors.

The definitions have been refined in response to many concerns that the proposed definition of ecological receptor was so broad that most sites would require an ecological risk assessment. However, the revisions to the definitions would still require many sites to make the demonstration that remaining contamination does not pose an adverse impacts to ecological receptors. Therefore, the Department has adopted an alternative approach. The Department will assume responsibility for identifying those sites with the potential for adverse impacts to ecological receptors. The site will be screened for the presence of ecological receptors and the presence of complete pathways of exposure to indicate potential impacts. An ecological risk assessment may be required at those sites where a potential exists for impacts to ecological receptors. The Department will develop guidance outlining the process it will use to determine when impacts to ecological receptors are anticipated and how to conduct an ecological risk assessment. Specifically, the guidance will provide assistance identifying: 1) ecological receptors; 2) complete exposure pathways; 3) bioaccumulation potential of contaminants; 4) acute toxicity; 5) lethal, mutagenic, teratogenic, and carcinogenic effects; 6) food chain impacts; and 7) transport mechanisms.

At the GRRC hearing, commenters argued that the ecological risk condition should be narrowed considerably or should be deleted from the rule. Subsequent to the GRRC meeting, the Task Force reiterated its position that protection of ecological receptors was a critical component of the rule and could not be deleted. Because the Task Force did not reach consensus on any

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language that would improve upon the adopted rule language, it was agreed that further refinement would be provided in guidance. Therefore, the Department has not made any changes to the adopted rule on this issue.

E. Implementation Issues

Several comments were received regarding rule implementation issues. While these were not rule comments per se, they are addressed here because a discussion of these implementation issues is helpful for an understanding of how the Department will apply the rule.

Protection of Groundwater Quality

The Department added the condition in R18-7-203(B)(1) regarding protection of groundwater quality so persons remediating soil would be assured that another program would not require additional soil remediation to protect groundwater. Guidance for the protection of groundwater quality was developed by the Leachability Subcommittee of the Task Force and published by the Department in September 1996. The guidance is helpful in making the required demonstration that soil concentrations remaining after remediation to the SRL or site-specific remediation level do not cause or threaten to cause contamination of groundwater. Although comments were received about the guidance document, it is not a part of this rulemaking.

For clarification, the groundwater protection levels (GPLs) are soil concentrations that are calculated using the procedures in the guidance document "A Screening Method to Determine Soil Concentrations Protective of Groundwater Quality." If the SRL or site-specific soil cleanup level is not protective of groundwater quality, a Minimum GPL can be used to ensure groundwater protection. As a 2nd option, Alternative GPLs can be determined using the ADEQ fate-and-transport model for organic chemicals, or the correlation method described in the guidance may be used to determine Alternative GPLs for inorganic contaminants. For organic chemicals, this 2nd option may be used if the site has been adequately characterized for depth to groundwater and depth of incorporation of the contaminant. For inorganic chemicals, this method may be used if an adequate site-specific correlation has been developed between total metals and the corresponding leachable fraction of those metals for soils at the site. Finally, the Department may approve a cleanup standard generated by a contaminant fate-and-transport model (the Department's or another model) for either organic or inorganic contaminants. This 3rd option can be used only if sufficient site characterization is performed to ensure that all the input parameters to the model are adequately specified.

The guidance GPLs were calculated assuming some generic soil characteristics. If these assumptions are not correct for a particular site (for example, coarse-grained or gravelly soils, fractured bedrock) then the resultant GPLs are not applicable. The guidance specifies the assumptions that were made in determining the default characteristics. It also specifies some conditions where use of the GPLs calculated with the model are not appropriate. It is the responsibility of the users of the guidance (both regulated community and Department staff) to be aware of the limitations of the model and the site characteristics before using the guidance and/or model. Additionally, the GPLs are generated using a model that simplistically simulates complex natural conditions. Therefore, if the GPLs predict no potential threat to groundwater quality but groundwater data indicate that an impact has occurred or will occur, the predictive results will give way to the real data, and additional remediation will be required.

Site Characterization

The Final Rule proposed that the Interim Rule would continue to apply to sites which have been completely characterized as of the effective date of the Final Rule. As a result, some commenters suggested that the rule should include further definition of how characterization should be performed. The Final Rule does not change the characterization requirements imposed by each Departmental program. For purposes of determining when the Final Rule applies, the Final Rule establishes when characterization is complete.

Underground Storage Tank State Assurance Fund (SAFE) Payments

When the Final Rule becomes effective, there will be a period of time during which the rule covering the payment from the Underground Storage Tank (UST) State Assurance Fund for soil cleanup (R18-12-605.01) will not have correct references to the provisions of 18 A.A.C. 7, Article 2. The period of time between finalization of this rule and the finalization of the technical revisions to R18-12-605.01 should be approximately 120-days. Very few soil remediations will likely be initiated and finalized during the 120-day estimated period. Nevertheless, the Department believes these cases should be handled in the following manner.

The Department reviewed several approaches for determining the eligible payment amounts for soil corrective action conducted during the period when the UST rule and the Final Rule do not interface correctly. During this period, the Department could: 1) Make no payments for soil remediation conducted during the period because no specific standard for determining payment amount exists; 2) Make payments based on the provisions of R18-12-605.01 in relation to the Interim Soil Remediation Standards Rule even though the Final Rule is applicable to some remediations; or 3) Make payments based on the intent of the UST rule in relation to the Final Rule. The Department has determined that this final approach is the most appropriate.

The determination to apply the intent of the provisions of R18-12-605.01 to those provisions of R18-7-201 et seq., in effect at the time UST soil corrective action is conducted is based on A.R.S. § 49-1052(O), which states: "The department shall provide coverage for corrective actions relating to soil remediation that are consistent with remediation standards developed pursuant to chapter 1, article 4 of this title." Further support for this choice is found at A.R.S. § 49-1054(A), as well as other places in that section which states that SAF payments made for corrective action costs must be "reasonable and necessary". To apply the remediation levels of the Interim Rule, when it has been replaced by Final Rule, contradicts the statutory intent. Although the citations may be temporarily inconsistent, the Department will apply the Final Rule, when effective, to UST sites.

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Exemption from Definition of Solid Waste

A comment was received that the Preamble to the Final Rule should clarify that soils which meet residential SRLs are exempt from the definition of solid waste and may be used off-site as fill or for other valid purposes. The comment was likely the result of language in A.R.S. § 49-701.01 which exempts on-site soils that meet the remediation standards in this rule from the definition of solid waste. Neither this rule Preamble, nor the rule itself, is the appropriate means of defining what is a solid waste.

F. Additional Explanatory Material

Two documents follow which contain additional explanatory material. The 1st document is a list of all persons who attended 1 or more meetings of the Task Force. The 2nd document sets forth the methodology used to develop the SRLs, which are found in Appendix A of the rule text.

Persons who attended 1 or more meetings of the Task Force, and the organization each represented:

Jo Ellen Alberhasky, City of Glendale
R. Douglas Bartlett, Dames and Moore
Michael E. Beasley, Texaco Refining and Marketing
Mohsen Belyami, City of Tucson
David Benjes, ATI
Steve Bennett, Scottsdale City Attorney's Office
Pamela Bennett, Valley Partnership
Mason Bolitho, Department of Water Resources
Steve Brittle, Don't Waste Arizona, Inc.
Steve Burg, Mesa City Attorney's Office
Scott Burge, Burge & Assoc.
James R. Cairns, City of Chandler Attorney's Office
Bill Cheatham, City of Yuma
Robert J. Drake, B.A. Liesch Associates, Inc.
Laurie Dryden, Arizona Dept of Real Estate
Marty Eroh, Arizona Public Service
Jon B. Fiegen, Attorney General's Office
Jerry Flannery, Town of Marana
Mike Frye, Exodyne Electric Motors
Harold E. Gill, Miller-Brooks Env., Inc.
Barbara Goldburg, City of Scottsdale
Randy Grant, City of Scottsdale
Dennis Green, Allied Signal Inc. Fluid Systems
Harley Grosvenor, City of Flagstaff
Linda Henry, Brown and Caldwell
Judy Heywood, Arizona Public Service Company
Raena Honan, Sierra Club
Todd Hook, Industrial Compliance
Michael Hulpke, AGRA Earth and Environmental
Lantz Indergaard, Geraghty and Miller Inc.
I.P. Jenkins, Shell Oil Company
Theresa Kalaghan, Delta Environmental Consultants
Dan Kelley, Tierra Dynamic
Waseem A. Khan, Miller Brooks Environmental, Inc.
Kathy Kirchner, Basin and Range
Phil Lagas, Basin and Range Hydrogeologists
Brian Law, Delta Environmental Consultants
Mark Leary, Browning Ferris Industries
Rick McNerney, Verde Companies
Sharen Meade, Hanson Meade & Campbell
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Brian Munson, Dames and Moore
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Steve Rakowski, Basin and Range
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Walter Rusinek, Gallagher & Kennedy
Shiela B. Schmidt, Arizona Public Service Company

Phillip A. Schneider, Delta Environmental
Lance Shea, Fulbright and Jaworski
Donn Stoltzfus, City of Phoenix
Tom Suriano, Motorola
Don Snyder, City of Tempe
Terry M. Temnick
Karen J. Tiggs, ADHS
Bruce C. Travers, Harding Lawson Association
Karen van Rijn, City of Tucson
William R. Victor, Errol L. Montgomery & Associates
Jim Weiss, Chandler City Attorney's Office
Steve Willis, Environ Science & Engineering, Inc.
G. Van Velsor Wolf Jr., Snell & Wilmer
Duane Yantorno, ASARCO Inc.
Christine Zielonka, Mesa City Attorney's Office
Alan Thomas, Brown & Caldwell
Don Richey, ADEQ
Bill Staudenmaier, Arizona Public Service Company
Mike Wood, Arizona Public Service Company
John Mieher, Environmental Science & Eng.
Tom Kirk, Del Webb Sun City West
Steven Burr, Lewis and Roca
James Coulbourne, Earth Research Tech.
Dennis Tucker, Malcolm - Pirnie
Steve Smith, Hydro Search Inc.
Kristen R. Boiline, Jamieson Gutierrez
Chuck White, WMX Technology
Rob Barnett, Waste Management
Laura Braddy, Geraghty & Miller
John Pearce, Attorney
John Godec, Godec, Randall & Assoc.
Michelle Bakkila, G & M
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Elijah Cardon, Cardon Oil
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Soil Remediation Levels (SRLs)

**Prepared by
The Office of Environmental Health**

**Prepared for
The Arizona Department of Environmental Quality**

1.0 INTRODUCTION

This document describes the residential and non-residential pre-determined risk-based soil remediation standards developed as part of the Soil Remediation Standards Rule (R18-7-201 et seq.). These standards, called Soil Remediation Levels (SRLs), have been calculated for the Arizona Department of Environmental Quality (ADEQ) by the Arizona Department of Health Services (ADHS), Office of Environmental Health. A listing of the SRLs can be found in Appendix A to the rule.

SRLs are protective of human health, including sensitive groups, over a lifetime. Chemical concentrations in soils that exceed SRLs may not necessarily represent a health risk. Rather, when contaminant concentrations in soil exceed these standards, further evaluation may be necessary to determine whether the site poses an unacceptable risk to human health.

SRLs are calculated using a human health-based approach that is generally consistent with risk assessment methodologies recommended by the United States Environmental Protection Agency (USEPA) and ADHS. The standards include exposure pathways for which generally accepted methods, models, and assumptions have been developed (that is, ingestion, inhalation, and dermal contact) for residential and non-residential land-use conditions.

SRLs consider human health risk from contact with soils, they do not take into account each chemical's capability to leach to groundwater. In addition, these standards are not applicable in determining whether threats to aquatic systems or wildlife exist.

2.0 METHODOLOGY

2.1 Overview

These standards were calculated using a human health based approach that is generally consistent with risk assessment methodologies recommended by the USEPA and the ADHS. The default exposure assumptions, toxicity values, soil characteristics, and physical constants used to calculate these standards are consistent with those used to develop the August 1, 1996, USEPA Region IX Preliminary Remediation Goals (PRGs).

SRLs protect against toxic doses of systemic toxicants, and limit excess lifetime cancer risk to 1-in-1,000,000 (1×10^{-6}) for known human carcinogens and to 1-in-100,000 (1×10^{-5}) for possible and probable human carcinogens. SRLs are risk-based with the exception that, for several non-carcinogenic volatile chemicals, the standards are limited to the concentration of free-phase product in 1% of the soil pore spaces. In addition, the SRLs for inorganic arsenic are based upon the average natural background level of arsenic found in Arizona soils.

2.2 Exposure Assumptions

SRLs use standard default exposure factors for ingestion, inhalation, and dermal exposure pathways under residential and non-residential land-use conditions. The default exposure factors were obtained primarily from *Risk Assessment Guidance for Superfund (RAGS)*, *Supplemental Guidance Standard Default Exposure Factors* (OSWER Directive, 9285.6-03) dated March 25, 1991, and more recent information from USEPA's Office of Solid Waste and Emergency Response, and the USEPA Office of Research and Development.

Residential SRLs

Residential SRLs assume an exposure frequency (EF) of 350 days/year. The exposure duration (ED) for carcinogens was assumed to be 30 years, with 6 of those years as a child and 24 years as an adult. Since exposure to contaminants in soil may be different for children and adults, carcinogenic risks during the 1st 30 years of life were calculated using age-adjusted exposure factors. These factors integrate exposure from birth until age 30, combining contact rates, body weights, and exposure durations for small children and adults. The age-adjusted factors have been developed using Equations 1, 2, and 3 in Section 3.0. Exposure doses are averaged over a lifetime (70 years) for carcinogens.

Residential SRLs are specifically protective of childhood exposure for systemic toxicity. Age-adjustment factors are not used in evaluating systemic toxicity. Exposure assumptions reflect childhood contact rates and body weight. The focus on children is protective of the higher daily intake rates by children and their lower body weight. For systemic toxicity, the exposure duration

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was assumed to be 350 days/year for 6 years. Exposure doses are averaged over the period of exposure (6 years) for systemic toxicity.

For carcinogens, SRLs are the lesser of the soil concentration based upon carcinogenicity using the age-adjusted factors and the concentration based upon systemic toxicity assuming childhood contact rates and body weight. Intakes specific to the routes of exposure (ingestion, inhalation, and dermal contact) are discussed in Sections 2.2.1 through 2.2.3.

Non-residential SRLs

Non-residential SRLs assume an exposure frequency of 250 days/year, which represents the typical number of workdays in a year. The exposure duration was assumed to be 25 years, which corresponds with the standard default number of years in the workplace. Exposure doses have been averaged over a lifetime (70 years) for carcinogens. Exposure was averaged over the period of exposure (25 years) for systemic toxicity. Intakes specific to the routes of exposure (ingestion, inhalation, and dermal contact) are discussed in Sections 2.2.1 through 2.2.3.

2.2.1 Ingestion Exposure

The method used to evaluate ingestion exposure applies risk assessment methods presented in RAGS Part B (USEPA 1991a) and is consistent with *USEPA Soil Screening Guidance: User's Guide and Technical Background Document* (USEPA 1996a,b) and USEPA Region IX PRGs (USEPA 1996c).

Residential SRLs

For carcinogens, residential SRLs use an age-adjusted soil ingestion factor that integrates ingestion rates, body weights, and exposure duration for small children and adults ($114 \text{ mg}\cdot\text{yr}/\text{kg}\cdot\text{day}$). Equation 1 in Section 3.0 was used to develop the ingestion adjustment factor (USEPA, 1991a,b). An age-adjustment factor is not used to evaluate systemic toxicity for residential SRLs, and ingestion exposure reflects a default childhood soil ingestion rate of $200 \text{ mg}/\text{day}$ (USEPA, 1991b).

Non-residential SRLs

Non-residential SRLs assume a standard default occupational/industrial soil ingestion rate of $50 \text{ mg}/\text{day}$ (USEPA, 1991b). An age-adjusted factor was not used for non-residential SRLs.

2.2.2 Inhalation Exposure

The models used to evaluate inhalation exposure use updates of risk assessment methods presented in RAGS Part B (USEPA, 1991a) and are generally consistent with *USEPA Soil Screening Guidance: User's Guide and Technical Background Document* (USEPA, 1996a,b) and USEPA Region IX PRGs (USEPA, 1996c). The equations and assumptions that relate concentrations of contaminants in soil to concentrations in air are discussed in this section under modeling.

Residential SRLs

Residential inhalation rates for carcinogens use an age-adjusted inhalation factor that integrates inhalation rates, body weight, and exposure duration for small children and adults ($11 \text{ m}^3\cdot\text{yr}/\text{kg}\cdot\text{day}$). Equation 2 in Section 3.0 was used to develop the inhalation adjustment factor (USEPA, 1991a,b). An age-adjustment factor is not used to evaluate systemic toxicity for residential SRLs, and inhalation exposure reflects the default childhood inhalation rate of $10 \text{ m}^3/\text{day}$ and default body weight of 15 kg (USEPA, 1989, 1991a,b).

Non-residential SRLs

Non-residential SRLs assume a standard default occupational inhalation rate of $20 \text{ m}^3/\text{workday}$ (USEPA, 1991b). An age-adjusted factor was not used for non-residential SRLs. Equations and assumptions that relate concentrations of contaminants in air to concentrations in soil are discussed below.

Modeling

The methods used to quantify exposure concentrations for volatiles and particulates apply updates of models presented in RAGS Part B (USEPA, 1991a) are generally consistent with *USEPA Soil Screening Guidance: User's Guide and Technical Background Document* (USEPA, 1996a,b) and USEPA Region IX PRGs (USEPA, 1996c).

The soil-to-air pathway calculations incorporate volatilization factors (VF_s) for volatile contaminants and a particulate emission factor (PEF) for nonvolatile contaminants. The VF_s and PEF factors convert soil contaminant concentrations to air concentrations. The equations include a model to estimate emissions from the soil and a model to simulate the dispersion of the contaminant in the atmosphere (Q/C).

The chemical-specific volatilization factor (VF_s) was used as a model to convert contaminant concentrations in soil to concentrations in air for chemicals that meet all of the following volatility criteria: 1) a Henry's Law constant in water at 25°C greater than 10^{-5} ($\text{atm}\cdot\text{m}^3/\text{mol}$), 2) a gram molecular weight of less than 200, and 3) a melting point of less than 25°C . Constituents that meet these criteria are identified in the attached worksheet.

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The emission terms used in the VF_s were calculated from physical-chemical information obtained from a number of sources including *Superfund Exposure Assessment Manual* (SEAM, USEPA, 1988), *Subsurface Contamination Reference Guide* (USEPA, 1990a), *Fate and Exposure Data* (Howard, 1991), and *Superfund Chemical Data Matrix* (USEPA, 1994). In those cases where Diffusivity Coefficients (D_i) were not provided in existing literature, D_i 's were calculated using Fuller's Method. A surrogate term was required for some chemicals that lacked physico-chemical information.

The VF_s model is applicable when the contaminant concentration in soil is at or below saturation (that is, there is no free-phase present). When contaminants reach the soil saturation limit, emission flux from soil to air reaches a plateau. Volatile emissions do not increase above this level no matter how much more chemical is added to the soil. Since the soil saturation limit corresponds to maximum volatile emissions, the inhalation route is not likely to be of concern for those chemicals with SRLs that exceed soil saturation limits (USEPA, 1996a).

However, at contaminant concentrations in excess of 3% of the volume of soil pore spaces, the contaminant may become mobile in the soil column. Therefore, if the concentration calculated using the integrated exposure equations was greater than the soil saturation limit plus free-phase in 1% of pore spaces, (chosen to provide an added safety margin), the SRL was limited to 1% free-phase concentration to prevent contaminant mobility. Equation 10 in Section 3.0 was used to develop the 1% free-phase concentration.

Inhalation of nonvolatile chemicals adsorbed to respirable particles (PM_{10}) were assessed using a default PEF of 1.316×10^9 m^3/kg that converts a contaminant concentration in soil to a concentration of respirable particles in the air from fugitive dust emissions. The generic PEF was derived using default values in Equation 11, which correspond to a receptor point concentration of approximately $0.76 \mu g/m^3$. The relationship is derived by Cowherd (1985) for a rapid assessment procedure applicable to a typical hazardous waste site where surface contamination provides a continuous and constant potential for emission over an extended period.

The dispersion term (Q/C) has been derived from a modeling exercise using meteorological data from 29 locations across the United States. The dispersion model for both volatiles and particulates is the AREA-ST, an updated version of the USEPA Office of Air Quality Planning and Standards, Industrial Source Complex Model, ISC2. Different Q/C terms are used in the VF and PEF equations. A default source size of 0.5 acres was chosen in calculating the standards. This is consistent with the default exposure area over which USEPA Region IX typically averages contaminant concentrations in soils.

2.2.3 Dermal Contact

The models used to evaluate dermal exposure apply updates of risk assessment methods presented in RAGS Part B (USEPA, 1991a) and are consistent with *USEPA Soil Screening Guidance: User's Guide and Technical Background Document* (USEPA, 1996a,b) and USEPA Region IX PRGs (USEPA, 1996c).

SRLs use chemical-specific dermal absorption values for cadmium, pentachlorophenol, PCBs, and dioxin recommended by the USEPA Office of Research and Development. For the remainder of the SRLs, standard default absorption values of 1% for inorganics and 10% for all other contaminants were used (Cal-EPA, 1994). All exposure scenarios assume a standard default skin adherence factor of 0.2 mg/cm^2 (USEPA, 1992b).

Residential SRLs

For residential SRLs, estimates of dermal contact with carcinogens are quantified using an age-adjusted skin contact factor that integrates skin surface area, body weight, and exposure duration for small children and adults ($503 \text{ mg}\cdot\text{yr/kg}\cdot\text{day}$). Equation 3 in Section 3.0 was used to develop the dermal adjustment factor (USEPA, 1991a). An age-adjustment factor is not used to evaluate systemic toxicity for residential SRLs, and dermal contact with soils are evaluated using a default childhood skin surface area of 2000 cm^2 and a default body weight of 15 kg (USEPA, 1989, 1992b).

Non-residential SRLs

Non-residential SRLs assume a standard default occupational adult skin surface area of 5000 cm^2 (USEPA, 1992b). Age-adjusted factors were not used for non-residential SRLs.

2.3 Toxicity Assessment

SRLs protect against toxic doses of systemic toxicants, and limit excess lifetime cancer risk to 1-in-1,000,000 (1×10^{-6}) for known human carcinogens and to 1-in-100,000 (1×10^{-5}) for possible and probable human carcinogens. The SRLs for arsenic are based upon the average natural background levels found in Arizona soils. The SRL for lead has been developed using the USEPA Integrated Exposure Uptake Biokinetic (IEUBK) Model (USEPA, 1994d).

Toxicity Value Sources

SRLs use USEPA non-carcinogenic reference doses (RfD) and carcinogenic slope factors (SF) from the USEPA Integrated Risk Information System (IRIS) through July 1996, USEPA Health Effects Assessment Summary Tables (HEAST) through May 1995, and the USEPA National Center for Environmental Assessment (NCEA). The priority among sources of toxicological constants used are as follows: (1) IRIS, (2) HEAST, (3) NCEA, and (4) withdrawn values from IRIS or HEAST and values under review.

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Route-to-route extrapolations were used when no toxicity values were available for a given route of exposure. For example, oral cancer slope factors and reference doses were used for oral and inhalation exposure when organic compounds lacked inhalation values. Inhalation slope factors and inhalation reference doses were used for oral exposure for organic compounds lacking oral values. In addition, oral toxicity values were used for calculating risk and hazard from dermal exposures.

Uncertainty exists in determining the risk and hazard associated with skin contact with soils. One important data gap is the lack of USEPA verified toxicity values for the dermal route. SRLs assume that dermal toxicity values can be route-to-route extrapolated from oral values.

Carcinogenicity

The USEPA's Carcinogen Advisory Group has grouped chemicals by weight-of-evidence (WoE) into classes from A to E, which designate their potential as a cancer-causing agent. The WoE represents the carcinogenicity evidence from human and animal studies and indicates the strength of the data. The A classification signifies that the chemical is a proven human carcinogen. Probable human carcinogens are designated either B1, showing that studies in humans are strongly suggestive but not conclusive, or B2 if the chemical has been conclusively carcinogenic in repeated animal studies but not conclusive in human studies. A chemical may be classified C, a possible human carcinogen, if a single high-quality animal study or several low-quality animal studies suggest carcinogenicity. If insufficient human and animal evidence is available to determine carcinogenicity, the chemical is classified as D. A chemical conclusively demonstrated to be non-carcinogenic to humans is in group E. This designation is rare due to the difficulty in producing the necessary negative data.

Lead

Since the USEPA has not published an RfD or SF for lead, the SRL for this compound has been developed using the USEPA IEUBK Model (USEPA, 1994d). The IEUBK model generates a probability distribution of blood lead levels for a population of children exposed to lead in a number of media. The distribution reflects the variability of blood lead levels in several communities. Lead exposures integrated in the model include dietary sources, drinking water, air, soil and household dust, and other sources. SRLs were generated assuming default assumptions for all media.

The SRLs for lead were designed to limit to 5% the percentage of children with blood lead levels in excess of 10 µg/dL. These criteria are based upon recommendations by the USEPA and the United States Center for Disease Control and Prevention (CDC) that there be no more than a 5% likelihood that a child exceeds a blood lead level of 10 µg/dL.

The residential SRL of 400 mg/kg represents a concentration of lead in soil that would be expected to limit to 5% the percentage of children with blood lead levels greater than the reportable limit of 10 µg/dL. The non-residential SRL of 2000 mg/kg represents a concentration of lead in soil that would be expected to limit to 5% the percentage of babies born with blood lead levels greater than 10 µg/dL in the exposed maternal population.

Hydrocarbon Mixtures (C₁₀ to C₃₂)

Soils contaminated with petroleum substances often contain hundreds of different hydrocarbons. This presents an obstacle in developing risk-based SRLs for hydrocarbon mixtures due to the variability in constituents at contaminated sites and the differing toxicity and carcinogenic potential among hydrocarbons. In order to develop SRLs for hydrocarbons, it was assumed that the gasoline range of hydrocarbons, up to C₁₀, is represented by the individual hydrocarbons that have available toxicity information and calculated SRLs. These hydrocarbons include benzene, toluene, ethylbenzene, and xylene. Therefore, it was necessary to establish a hydrocarbon standard for more than 10 carbon atoms. Due to the fact that diesel fuel contains hydrocarbons which predominantly span a carbon number range of C₉ to C₂₂, the decision was made to develop SRLs for a range of hydrocarbons similar in content to diesel fuel.

Lifetime dermal studies for Diesel Fuel No. 2 analyzed and evaluated by Millner et. al. in *Human-Based Soil Cleanup Guidelines for Diesel Fuel No. 2* (Journal of Soil Contamination, 1992) were selected as the basis for deriving a cancer slope for hydrocarbons. The cancer slope factor used in developing the hydrocarbon SRLs is the geometric mean of the 95% upper confidence limit of cancer potency factors derived from 21 toxicological studies of diesel fuel mixtures. Since there are no studies that have established diesel fuel as a known human carcinogen, the SRLs are calculated using a target cancer risk of 1×10^{-5} . Exposure assumptions for calculating these SRLs are identical to those used for non-volatile organic compounds.

Arsenic

The SRLs for inorganic arsenic are based upon the average naturally occurring levels found in Arizona soils. Soil samples collected by the United States Geological Survey (USGS) from 47 locations around the state found that naturally occurring arsenic concentrations range from 1.4 mg/kg to 97 mg/kg, with an average of 9.8 mg/kg (Earth Technology, 1991). The USGS data represent broad coverage for the state, and are considered to be representative of what arsenic concentrations might be for the state as a whole. The residential and non-residential SRLs for arsenic, therefore, were set at 10 mg/kg, reflecting a conservative yet reasonable estimate for Arizona soils.

3.0 SUMMARY

SRLs have been calculated using a human health-based approach that is generally consistent with risk assessment methodologies recommended by the USEPA and the ADHS. They protect against toxic doses of systemic toxicants, and limit excess lifetime cancer risk to 1-in-1,000,000 (1×10^{-6}) for known human carcinogens and to 1-in-100,000 (1×10^{-5}) for possible and

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probable human carcinogens. For lead, the SRLs are designed to limit to 5% the percentage of exposed children with blood lead levels in excess of the reportable limit of 10 µg/dL. SRLs are risk-based with the exception that, for several volatile chemicals, the standards are limited to the concentration of free-phase product in 1% of the soil pore spaces. In addition, the residential and non-residential inorganic arsenic SRLs have been based upon the average natural background level of arsenic found in Arizona soils (Earth Technology, 1991).

The formulas used to calculate SRLs are presented in Equations 1 through 11. The equations calculate a soil concentration from a target risk for carcinogenicity and a hazard quotient for systemic toxicity. For carcinogens, final SRLs are the lesser of the concentration in soil based upon carcinogenicity or systemic toxicity. The equations combine exposure from ingestion, inhalation, and skin contact.

Equations 1 through 3 display the formulas used to calculate the age-adjusted factors used in residential SRLs to integrate childhood and adult exposure for carcinogens. These factors approximate the integrated exposure from birth until age 30, combining contact rates, body weights, and exposure durations for small children and adults for each exposure route.

Equation 4 displays the formula used to calculate residential SRLs based upon carcinogenicity. Equation 5 displays the formula used to calculate residential SRLs based upon systemic toxicity. Table 1 displays the exposure factors used to calculate residential SRLs.

Equation 6 displays the formula used to calculate non-residential SRLs based upon carcinogenicity. Equation 7 displays the formula used to calculate non-residential SRLs based upon systemic toxicity. Table 1 displays the exposure factors used to calculate non-residential SRLs.

The chemical-specific volatilization factor described in Equation 8 was used as a model to convert contaminant concentrations in soil to concentrations in air for chemicals that meet the volatility criteria in Section 2.2.2. Modeling was not required for ingestion and dermal exposure.

If the concentration calculated using the integrated exposure equations was less than the total soil concentration saturation limit plus free-phase in 1% of the pore space, the SRL was limited to the health-based level calculated from the exposure equations. The formulas for calculating these limits are presented in Equations 9 and 10.

Inhalation of chemicals adsorbed to respirable particles (PM₁₀) were assessed using a default PEF equal to 1.316×10^9 m³/kg that relates the contaminant concentration in soil with the concentration of respirable particles in the air from fugitive dust emissions. The PEF was derived using the default values in Equation 11.

Table 1: STANDARD DEFAULT FACTORS

<u>Symbol</u>	<u>Definition (units)</u>	<u>Default</u>	<u>Reference</u>
CSFo	Cancer slope factor oral (mg/kg-d)-1	--	IRIS, HEAST, or NCEA
CSFi	Cancer slope factor inhaled (mg/kg-d)-1	--	IRIS, HEAST, or NCEA
RfDo	Reference dose oral (mg/kg-d)	--	IRIS, HEAST, or NCEA
RfDi	Reference dose inhaled (mg/kg-d)	--	IRIS, HEAST, or NCEA
TR _A	Target cancer risk (WoE = A) ^a	10 ⁻⁶	--
TR _{B,C}	Target cancer risk (WoE = B1, B2, C) ^b	10 ⁻⁵	--
THQ	Target hazard quotient	1	--
BWa	Body weight, adult (kg)	70	RAGS (Part A), USEPA 1989 (EPA/540/1-89/002)
BWc	Body weight, child (kg)	15	Exposure Factors, USEPA 1991 (OSWER No. 9285.6-03)
ATc	Averaging time - carcinogens (days)	25550	RAGS(Part A), USEPA 1989 (EPA/540/1-89/002)
ATn	Averaging time - noncarcinogens (days)	ED*365	
SAa	25% Surface area, adult (cm ² /day)	5000	Dermal Assessment, USEPA 1992 (EPA/600/8-91/011B)
SAc	25% Surface area, child (cm ² /day)	2000	Dermal Assessment, USEPA 1992 (EPA/ 600/8-9/011B)
AF	Adherence factor (mg/cm ²)	0.2	Dermal Assessment, USEPA 1992 (EPA/600/8-9/011B)
ABS	Skin absorption (unitless.); -- organics --Inorganics	0.1 0.01	PEA, Cal-EPA (DTSC, 1994) PEA, Cal-EPA (DTSC, 1994)
IRa _a	Inhalation rate - adult (m ³ /day)	20	Exposure Factors, USEPA 1991 (OSWER No. 9285.6-03)
IRa _c	Inhalation rate - child (m ³ /day)	10	RAGS (Part A), USEPA 1989 (EPA/540/1-89/002)
IRs _a	Soil ingestion - adult (mg/day)	100	Exposure Factors, USEPA 1991 (OSWER No. 9285.6-03)
IRs _c	Soil ingestion - child (mg/day),	200	Exposure Factors, USEPA 1991 (OSWER No. 9285.6-03)

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IRSo	Soil ingestion - occupational (mg/day)	50	Exposure Factors, USEPA 1991 (OSWER No. 9285.6-03)
EFr	Exposure frequency - residential (d/y)	350	Exposure Factors, USEPA 1991 (OSWER No. 9285.6-03)
EFo	Exposure frequency - occupational (d/y)	250	Exposure Factors, USEPA 1991 (OSWER No. 9285.6-03)
EDr	Exposure duration - residential (years)	30 ^c	Exposure Factors, USEPA 1991 (OSWER No. 9285.6-03)
	Exposure duration - child (years)	6	Exposure Factors, USEPA 1991 (OSWER No. 9285.6-03)
EDo	Exposure duration - occupational (years)	25	Exposure Factors, USEPA 1991 (OSWER No. 9285.6-03)
	Age-adjusted factors for carcinogens:		
IFSadj	Ingestion factor, soils ([mg•yr]/[kg•d])	114	RAGS (Part B), USEPA 1991 (OSWER No. 9285.7-01B)
SFSadj	Skin contact factor, soils ([mg•yr]/[kg•d])	503	By analogy to RAGS (Part B)
InhFadj	Inhalation factor ([m ³ •yr]/[kg•d])	11	By analogy to RAGS (Part B)
PEF	Particulate emission factor (m ³ /kg)	1.396 x 10 ⁺⁹	Soil Screening Guidance (USEPA 1996a,b)
VF _s	Volatilization factor for soil (m ³ /kg)	Chem. Specific	Soil Screening Guidance (USEPA 1996a,b)
sat	Soil saturation concentration (mg/kg)	Chem. Specific	Soil Screening Guidance (USEPA 1996a,b)

Footnotes:

^a USEPA Carcinogenic Weight of Evidence (WoE) Classification for Known Human Carcinogens

^b USEPA Carcinogenic Weight of Evidence (WoE) Classification for Probable Human Carcinogens (WoE = B1 or B2) and Possible Human Carcinogens (WoE = C)

^c Exposure duration for lifetime residents is assumed to be 30 years. For carcinogens, exposures are integrated for childhood (6 years) and adulthood (24 years).

Equations

Equation 1: Integrated Ingestion Adjustment Factor for Residential Exposure to Carcinogens

$$IFS_{adj} = \frac{ED_c \times IRS_c}{BW_c} + \frac{(ED_r - ED_c) \times IRS_a}{BW_a}$$

Equation 2: Integrated Inhalation Adjustment Factor for Residential Exposure to Carcinogens

$$InhF_{adj} = \frac{ED_c \times IRA_c}{BW_c} + \frac{(ED_r - ED_c) \times IRA_a}{BW_a}$$

Equation 3: Integrated Dermal Adjustment Factor for Residential Exposure to Carcinogens

$$SFS_{adj} = \frac{ED_c \times AF \times SA_c}{BW_c} + \frac{(ED_r - ED_c) \times AF \times SA_a}{BW_a}$$

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Equation 4: Combined Exposures to Carcinogenic Contaminants in Residential Soil

$$C(\text{mg/kg}) = \frac{TR \times AT_c}{EF_r \left[\left(\frac{IFS_{adj} \times CSF_o}{10^6 \text{mg/kg}} \right) + \left(\frac{SFS_{adj} \times ABS \times CSF_o}{10^6 \text{mg/kg}} \right) + \left(\frac{InhF_{adj} \times CSF_i}{VF_s^a} \right) \right]}$$

Equation 5: Combined Exposures to Noncarcinogenic Contaminants in Residential Soil

$$C(\text{mg/kg}) = \frac{THQ \times BW_c \times AT_n}{EF_r \times ED_c \left[\left(\frac{1}{RfD_o} \times \frac{IRS_c}{10^6 \text{mg/kg}} \right) + \left(\frac{1}{RfD_o} \times \frac{SA_c \times AF \times ABS}{10^6 \text{mg/kg}} \right) + \left(\frac{1}{RfD_i} \times \frac{IRA_c}{VF_s^a} \right) \right]}$$

Equation 6: Combined Exposures to Carcinogenic Contaminants in Non-residential Soil

$$C(\text{mg/kg}) = \frac{TR \times BW_a \times AT_c}{EF_o \times ED_o \left[\left(\frac{IRS_o \times CSF_o}{10^6 \text{mg/kg}} \right) + \left(\frac{SA_a \times AF \times ABS \times CSF_o}{10^6 \text{mg/kg}} \right) + \left(\frac{IRA_a \times CSF_i}{VF_s^a} \right) \right]}$$

Equation 7: Combined Exposures to Noncarcinogenic Contaminants in Non-residential Soil

$$C(\text{mg/kg}) = \frac{THQ \times BW_a \times AT_n}{EF_o \times ED_o \left[\left(\frac{1}{RfD_o} \times \frac{IRS_o}{10^6 \text{mg/kg}} \right) + \left(\frac{1}{RfD_o} \times \frac{SA_a \times AF \times ABS}{10^6 \text{mg/kg}} \right) + \left(\frac{1}{RfD_i} \times \frac{IRA_a}{VF_s^a} \right) \right]}$$

Equation 8: Derivation of the Volatilization Factor

$$VF_s (\text{m}^3/\text{kg}) = (Q/C) \times \frac{(3.14 \times D_A \times T)^{1/2}}{(2 \times \rho_b \times D_A)} \times 10^{-4} (\text{m}^2/\text{cm}^2)$$

Where:

$$D_A = \frac{[(\Theta_a^{10/3} D_i H' + \Theta_w^{10/3} D_w) / n^2]}{\rho_b K_d + \Theta_w + \Theta_a H'}$$

Parameter	Definition (units)	Default
VF _s	Volatilization factor (m ³ /kg)	--
D _A	Apparent diffusivity (cm ² /s)	--
Q/C	Inverse of the mean conc. at the center of a 0.5-acre square source (g/m ² -s per kg/m ³)	68.81
T	Exposure interval (s)	9.5 x 10 ⁸

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p_b	Dry soil bulk density (g/cm ³)	1.5
Θ_a	Air filled soil porosity (L_{air}/L_{soil})	0.28 or $n - \Theta_w$
n	Total soil porosity (L_{pore}/L_{soil})	0.43 or $1 - (p_b/p_s)$
Θ_w	Water-filled soil porosity (L_{water}/L_{soil})	0.15
p_s	Soil particle density (g/cm ³)	2.65
D_i	Diffusivity in air (cm ² /s)	Chemical-specific
H	Henry's Law constant (atm-m ³ /mol)	Chemical-specific
H'	Dimensionless Henry's Law constant	Calculated from H by multiplying by 41 (USEPA 1991a)
D_w	Diffusivity in water (cm ² /s)	Chemical-specific
K_d	Soil-water partition coefficient (cm ³ /g) = $K_{oc}f_{oc}$	Chemical-specific
K_{oc}	Soil organic carbon-water partition coefficient (cm ³ /g)	Chemical-specific
f_{oc}	Fraction organic carbon in soil (g/g)	0.006 (0.6%)

Equation 9: Derivation of the Soil Saturation Limit

$$sat = \frac{S}{\rho_b} (K_d \rho_b + \Theta_w + H' \Theta_a)$$

<u>Parameter</u>	<u>Definition (units)</u>	<u>Default</u>
sat	Soil saturation concentration (mg/kg)	--
S	Solubility in water (mg/L-water)	Chemical-specific
p_b	Dry soil bulk density (kg/L)	1.5
n	Total soil porosity (L_{pore}/L_{soil})	0.43 or $1 - (p_b/p_s)$
p_s	Soil particle density (kg/L)	2.65
K_d	Soil-water partition coefficient (L/kg)	$K_{oc} \times f_{oc}$ (chemical-specific)
k_{oc}	Soil organic carbon/water partition coefficient (L/kg)	Chemical-specific
f_{oc}	Fraction organic carbon content of soil (g/g)	0.006
Θ_w	Water-filled soil porosity (L_{water}/L_{soil})	0.15
Θ_a	Air filled soil porosity (L_{air}/L_{soil})	0.28 or $n - \Theta_w$
w	Average soil moisture content (kg _{water} /kg _{soil} or L _{water} /kg _{soil})	0.1
H	Henry's Law constant (atm-m ³ /mol)	Chemical-specific
H'	Dimensionless Henry's Law constant	$H \times 41$, where 41 is a units conversion factor

Equation 10: Derivation of the Contaminant Concentration at 1% Free-Phase

$$C_{1\%} = sat + \frac{n n_r \rho_f}{\rho_b} \times 10^6 \text{ (mg} \cdot \text{cm}^3 / \text{g} \cdot \text{L)}$$

<u>Parameter</u>	<u>Definition (units)</u>	<u>Default</u>
$C_{1\%}$	Contaminant concentration at 1% Free-Phase (mg/kg)	--
sat	Soil saturation concentration (mg/kg)	Chemical-specific
n	Total soil porosity (L_{pore}/L_{soil})	0.43
n_r	Residual in saturation in free-product phase (L_{FP}/L_{pore})	0.01

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P _f	Fluid density of contaminant (g/cm ³)	Chemical-specific
P _b	Dry soil bulk density (kg/L)	1.5

Equation 11: Derivation of the Particulate Emission Factor

$$PEF (m^3/kg) = Q/C \times \frac{3600 s/h}{0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x)}$$

<u>Parameter</u>	<u>Definition (units)</u>	<u>Default</u>
PEF	Particulate emission factor (m ³ /kg)	1.316 x 10 ⁹
Q/C	Inverse of the mean concentration at the center of a 0.5-acre-square source	90.80
V	Fraction of vegetative cover (unitless)	(g/m ² -s per kg/m ³)
U _m	Mean annual windspeed (m/s)	0.5
U _t	Equivalent threshold value of windspeed at 7 m (m/s)	4.69
F(x)	Function dependent on U _m /U _t derived using Cowherd (1985) (unitless)	11.32
		0.194

Footnote:

^a Volatilization Factor (VF_s) from equation 8 used for VOCs. Particulate Emission Factor (PEF) from equation 10 used for semi-volatile and non-volatile constituents.

GLOSSARY

ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
A.R.S.	Arizona Revised Statutes
CDC	US Center for Disease Control and Prevention
Di	Diffusivity Coefficient
ED	Exposure Duration
EF	Exposure Frequency
HEAST	USEPA Health Effects Assessment Summary Tables
IEUBK	USEPA Integrated Exposure Uptake Biokinetic Model
IRIS	USEPA Integrated Risk Information System
NCEA	USEPA National Center for Environmental Assessment
PEF	Particulate Emission Factor
PRG	Preliminary Remediation Goal
Q/C	Atmospheric Dispersion Term
RAGS	Risk Assessment Guidance for Superfund
RfD	Noncarcinogenic Reference Dose
SEAM	Superfund Exposure Assessment Manual
SF	Carcinogenic Slope Factor
SRL	Soil Remediation Level
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VF	Volatilization Factor
WoE	Weight of Evidence

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22. USEPA 1996c. *Region IX Preliminary Remediation Goals (PRGs)*. August 1, 1996. <http://www.epa.gov/region9>
23. USEPA 1996d. *Integrated Risk Information System (IRIS)*. Duluth, MN.

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WORKSHEET FOR DEVELOPING SRLs

Chemical Name	SFO 1/(mg/kg-d)	RfD (mg/kg-d)	SFI 1/(mg/kg-d)	RfD1 (mg/kg-d)	ABS (unitless)	VPEF (hr/kg)	Volatile	SAT (mg/kg)	1% FP (mg/kg)	CARCINOGENICITY			SYSTEMIC TOXICITY		
										Residential (mg/kg)	Non-Residential (mg/kg)	Residential (mg/kg)	Residential (mg/kg)	Non-Residential (mg/kg)	Residential (mg/kg)
Acetate	8.7E-03 i	4.0E-03 i	8.7E-03 i	4.0E-03 i	0.10	1.3E+09	N	1.0E+06		5.1E+02	2.2E+03	2.6E+02	2.7E+03		
Acetaldehyde	7.7E-03 i	2.6E-03 i	7.7E-03 i	2.6E-03 i	0.10	1.3E+04	Y	2.1E+05		9.1E+01	2.1E+02	3.9E+01	1.5E+02		
Acetochlor	2.0E-02 i	2.0E-02 i	2.0E-02 i	2.0E-02 i	0.10	1.3E+09	N	1.0E+06				1.3E+03	1.4E+04		
Acetone	1.0E-01 i	1.0E-01 i	1.0E-01 i	1.0E-01 i	0.10	2.0E+04	Y	1.1E+05				2.1E+03	8.8E+03		
Acetone cyanohydrin	8.0E-04 h	2.9E-03 x	2.9E-03 x	2.9E-03 x	0.10	1.3E+09	N	1.0E+06				5.7E+01	5.5E+02		
Acetonitrile	6.0E-03 i	1.4E-02 h	1.4E-02 h	1.4E-02 h	0.10	2.3E+04	Y	1.9E+05				2.2E+02	1.2E+03		
Acetophenone	1.0E-01 i	5.7E-06 x	5.7E-06 x	5.7E-06 x	0.10	5.3E+04	Y	1.7E+03				4.9E-01	1.6E+00		
Acidfluorfen	1.3E-02 i	1.3E-02 i	1.3E-02 i	1.3E-02 i	0.10	1.3E+09	N	1.0E+06				8.5E+02	8.9E+03		
Acrolein	2.0E-02 h	5.7E-06 i	5.7E-06 i	5.7E-06 i	0.10	1.2E+04	Y	4.8E+04				1.0E-01	3.4E-01		
Acrylamide	4.6E+00 i	2.0E-04 i	4.6E+00 i	2.0E-04 i	0.10	1.3E+09	N	1.0E+06		9.8E-01	4.2E+00	1.3E-01	1.4E+02		
Acrylic acid	5.0E-01 i	2.9E-04 i	2.9E-04 i	2.9E-04 i	0.10	1.3E+09	N	1.0E+06				3.1E+04	2.9E+05		
Acrylonitrile	1.0E-03 h	2.4E-01 i	2.4E-01 i	2.4E-01 i	0.10	9.0E+03	Y	8.4E+03		1.9E+00	4.7E+00	7.2E+00	2.5E+01		
Alachlor	8.1E-02 h	1.0E-02 i	8.0E-02 i	1.0E-02 i	0.10	1.3E+09	N	1.0E+06		5.5E+01	2.4E+02	6.5E+02	6.8E+03		
Alar	1.5E-01 i	1.5E-01 i	1.5E-01 i	1.5E-01 i	0.10	1.3E+09	N	1.0E+06				9.8E+03	1.0E+05		
Aldicarb	1.0E-03 i	1.0E-03 i	1.0E-03 i	1.0E-03 i	0.10	1.3E+09	N	1.0E+06				6.5E+01	6.8E+02		
Aldicarb sulfone	1.0E-03 i	1.0E-03 i	1.0E-03 i	1.0E-03 i	0.10	1.3E+09	N	1.0E+06				6.5E+01	6.8E+02		
Aldrin	1.7E+01 i	3.0E-05 i	1.7E+01 i	3.0E-05 i	0.10	1.3E+09	N	1.0E+06		2.6E-01	1.1E+00	2.0E+00	2.0E+01		
Allyl	2.5E-01 i	2.5E-01 i	2.5E-01 i	2.5E-01 i	0.10	1.3E+09	N	1.0E+06				1.6E+04	1.7E+05		
Allyl alcohol	5.0E-03 x	5.0E-03 x	5.0E-03 x	5.0E-03 x	0.10	1.3E+09	N	1.0E+06				3.3E+02	3.4E+03		
Allyl chloride	5.0E-02 h	2.9E-04 i	2.9E-04 i	2.9E-04 i	0.10	1.3E+09	N	1.0E+06				3.2E+03	3.3E+04		
Aluminum	1.0E+00 h	1.0E+00 h	1.0E+00 h	1.0E+00 h	0.01	1.3E+09	N	1.0E+06				7.7E+04	1.7E+06		
Aluminum phosphide	4.0E-04 i	4.0E-04 i	4.0E-04 i	4.0E-04 i	0.01	1.3E+09	N	1.0E+06				3.1E+01	6.8E+02		
Amdro	3.0E-04 i	3.0E-04 i	3.0E-04 i	3.0E-04 i	0.10	1.3E+09	N	1.0E+06				2.0E+01	2.0E+02		
Amesyn	9.0E-03 i	9.0E-03 i	9.0E-03 i	9.0E-03 i	0.10	1.3E+09	N	1.0E+06				5.9E+02	6.1E+03		
m-Aminophenol	7.0E-02 h	7.0E-02 h	7.0E-02 h	7.0E-02 h	0.10	1.3E+09	N	1.0E+06				4.6E+03	4.8E+04		
4-Aminopyridine	2.0E-05 h	2.0E-05 i	2.0E-05 i	2.0E-05 i	0.10	1.3E+09	N	1.0E+06				1.3E+00	1.4E+01		
Amibaz	2.5E-03 i	2.5E-03 i	2.5E-03 i	2.5E-03 i	0.10	1.3E+09	N	1.0E+06				1.6E+02	1.7E+03		
Ammonia	2.9E-02 i	2.9E-02 i	2.9E-02 i	2.9E-02 i	n/a	1.3E+09	N	1.0E+06				2.2E+03	5.8E+04		
Ammonium sulfamate	2.0E-01 i	2.0E-01 i	2.0E-01 i	2.0E-01 i	0.10	1.3E+09	N	1.0E+06				1.3E+04	1.4E+05		
Aniline	5.7E-03 i	2.9E-04 i	5.7E-03 i	2.9E-04 i	0.10	1.3E+09	N	1.0E+06		7.8E+02	3.3E+03	1.9E+01	2.0E+02		
Antimony and compounds	4.0E-04 i	4.0E-04 i	4.0E-04 i	4.0E-04 i	0.01	1.3E+09	N	1.0E+06				3.1E+01	6.8E+02		
Antimony pentoxide	5.0E-04 h	5.0E-04 h	5.0E-04 h	5.0E-04 h	0.01	1.3E+09	N	1.0E+06				3.8E+01	8.5E+02		
Antimony potassium tartrate	9.0E-04 h	9.0E-04 h	9.0E-04 h	9.0E-04 h	0.01	1.3E+09	N	1.0E+06				6.9E+01	1.5E+03		
Antimony tetroxide	4.0E-04 h	4.0E-04 h	4.0E-04 h	4.0E-04 h	0.01	1.3E+09	N	1.0E+06				3.1E+01	6.8E+02		
Antimony trioxide	4.0E-04 h	4.0E-04 h	4.0E-04 h	4.0E-04 h	0.01	1.3E+09	N	1.0E+06				3.1E+01	6.8E+02		
Apollo	1.3E-02 i	1.3E-02 i	1.3E-02 i	1.3E-02 i	0.10	1.3E+09	N	1.0E+06				8.5E+02	8.9E+03		
Artemite	5.0E-02 h	5.0E-02 h	5.0E-02 h	5.0E-02 h	0.10	1.3E+09	N	1.0E+06		1.8E+02	7.6E+02	3.3E+03	3.4E+04		
Artenic	Based on natural background of 10 mg/kg														
Assure	9.0E-03 i	9.0E-03 i	9.0E-03 i	9.0E-03 i	0.10	1.3E+09	N	1.0E+06				5.9E+02	6.1E+03		

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Chemical Name	SF ₀ 1/(mg/kg-d)	RMD ₀ (mg/kg-d)	SFI 1/(mg/kg-d)	RMD (mg/kg-d)	ABS (unit/lb)	VF/EF (m ² /kg)	Volat ^{le}	SAT (mg/kg)	CARCINOGENICITY		SYSTEMIC TOXICITY	
									Residential (mg/kg)	Non-Residential (mg/kg)	Residential (mg/kg)	Non-Residential (mg/kg)
Asulam												
Atrazine												
Avermectin B1												
Azobenzene												
Barium and compounds												
Baygon												
Bayleton												
Baythroid												
Benfen												
Benzomyl												
Benazon												
Benzaldehyde												
Benzene												
Benzidine												
Benzoic acid												
Benzotrichloride												
Benzyl alcohol												
Benzyl chloride												
Beryllium and compounds												
Bidin												
Biphenyl (Talsar)												
1,1-Biphenyl												
Bis(2-chloroethyl)ether												
Bis(2-chloroisopropyl)ether												
Bis(chloromethyl)ether												
Bis(2-chloro-1-methylethyl)ether												
Bis(2-ethylhexyl)phthalate (DEHP)												
Bisphenol A												
Boron												
Bromodichloromethane												
Bromoform (bromomethane)												
Bromomethane												
Bromophos												
Bromoxynil												
Bromoxynil octanoate												
1,3-Butadiene												
1-Butanol												
Butylate												
Butyl benzyl phthalate												
Butylphenyl butylacrylate												

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Chemical Name	SFO 1/(mg/kg-d)	RD ₅₀ (mg/kg-d)	SFI 1/(mg/kg-d)	RDI (mg/kg-d)	ABS (unitless)	VF/PEF (m ³ /kg)	Volatile	SAT (mg/kg)	1% FP (mg/kg)	CARCINOGENICITY Residential Non-Residential (mg/kg)	SYSTEMIC TOXICITY Residential Non-Residential (mg/kg)
Cacodylic acid		3.0E-03 h		3.0E-03 i	0.10	1.3E+09	N	1.0E+06			2.0E+03
Cadmium and compounds		5.0E-04 i	6.3E+00 i	5.7E-05 x	0.01	1.3E+09	N	1.0E+06		1.4E+04	2.0E+01
Caproketam		5.0E-01 i		5.0E-01 i	0.10	1.3E+09	N	1.0E+06			3.8E+01
Caplafoel		8.6E-03 h	8.6E-03 i	2.0E-03 i	0.10	1.3E+09	N	1.0E+06			3.4E+05
Caplan		3.5E-03 h	3.5E-03 i	1.3E-01 i	0.10	1.3E+09	N	1.0E+06		5.2E-02	1.4E+03
Carbaryl		1.0E-01 i		1.1E-01 i	0.10	1.3E+09	N	1.0E+06		1.3E+03	8.5E+03
Carbazole		2.0E-02 h	2.0E-02 i		0.10	1.3E+09	N	1.0E+06			6.5E+03
Carbofuran		5.0E-03 i		5.0E-03 i	0.10	1.3E+09	N	1.0E+06		2.2E-02	0.0E+00
Carbon disulfide		1.0E-01 i		2.9E-03 h	0.10	1.7E+03	Y	1.5E+03			3.4E+03
Carbon tetrachloride		7.0E-04 i	5.3E-02 i	5.7E-04 h	0.10	1.9E+03	Y	7.1E+02			7.5E+00
Carbosulfon		1.0E-02 i		1.0E-02 i	0.10	1.3E+09	N	1.0E+06		2.2E+00	5.5E+00
Carboxin		1.0E-01 i		1.0E-01 i	0.10	1.3E+09	N	1.0E+06			6.5E+03
Chloral		2.0E-03 i		2.0E-03 i	0.10	1.3E+09	N	1.0E+06			6.5E+03
Chloramben		1.5E-02 i		1.5E-02 i	0.10	1.3E+09	N	1.0E+06			1.4E+03
Chloranil		4.0E-01 h	4.0E-01 i		0.10	1.3E+09	N	1.0E+06		1.1E+01	9.8E+02
Chlorane		1.3E+00 i	1.3E+00 i	6.0E-05 i	0.10	1.3E+09	N	1.0E+06		4.7E+01	1.0E+04
Chlorimuron-ethyl		2.0E-02 i		2.0E-02 i	0.10	1.3E+09	N	1.0E+06		3.4E+00	3.9E+00
Chloroacetic acid		2.0E-03 h		2.0E-03 i	0.10	1.3E+09	N	1.0E+06			1.3E+03
2-Chloroacetophenone		8.6E-06 i		8.6E-06 i	0.10	1.3E+09	N	1.0E+06			5.9E+00
4-Chloroaniline		4.0E-03 i		4.0E-03 i	0.10	1.3E+09	N	1.0E+06			2.6E+02
Chlorobenzene		2.0E-02 i		5.7E-03 h	0.10	7.6E+03	Y	9.8E+02			2.7E+03
Chlorobenzilate		2.7E-01 h	2.7E-01 h	2.0E-02 i	0.10	1.3E+09	N	1.0E+06		1.6E+01	6.5E+01
p-Chlorobenzoic acid		2.0E-01 h	2.0E-01 h	2.0E-01 i	0.10	1.3E+09	N	1.0E+06		7.1E+01	2.2E+02
4-Chlorobenzothiazole		2.0E-02 h		2.0E-02 i	0.10	1.3E+09	N	1.0E+06			1.3E+03
2-Chloro-1,3-butadiene		2.0E-02 h		2.0E-02 i	0.10	1.3E+09	N	1.0E+06			1.3E+04
1-Chlorobutane		4.0E-01 h		4.0E-01 i	0.10	1.2E+03	Y	4.8E+02			1.3E+03
1-Chloro-1,1-difluoroethane		1.4E+01 i		1.4E+01 i	0.10	1.2E+03	Y	4.8E+02	3.0E+03		3.6E+00
Chlorodifluoromethane		1.4E+01 i		1.4E+01 i	0.10	1.1E+03	Y	3.4E+02	2.8E+03		7.1E+02
Chloroform		6.1E-03 i	8.1E-02 i	1.0E-02 i	0.10	3.0E+03	Y	2.5E+03	2.8E+03		2.3E+04
Chloromethane		1.3E-02 h	6.3E-03 h		0.10	1.2E+03	Y	4.0E+03		2.5E+00	2.3E+04
4-Chloro-2-methylpyridine		5.8E-01 h	5.8E-01 i		0.10	1.3E+09	N	1.0E+06		1.2E+01	4.4E+01
4-Chloro-2-methylpyridine hydrochloride		4.6E-01 h	4.6E-01 i		0.10	1.3E+09	N	1.0E+06		2.6E+01	0.0E+00
beta-Chloronaphthalene		8.0E-02 i		8.0E-02 i	0.10	1.3E+09	N	1.0E+06		3.3E+01	0.0E+00
o-Chloronitrobenzene		2.5E-02 h	2.5E-02 i		0.10	1.3E+09	N	1.0E+06		4.1E+01	0.0E+00
p-Chloronitrobenzene		1.8E-02 h	1.8E-02 i		0.10	1.3E+09	N	1.0E+06		1.8E-02	5.2E+03
2-Chlorophenol		5.0E-03 i		5.0E-03 i	0.10	1.3E+09	N	1.0E+06		7.6E+02	0.0E+00
2-Chloropropane		2.9E-02 i		2.9E-02 h	0.10	1.6E+04	Y	1.5E+04		2.5E-02	0.0E+00
Chlorethanol		1.1E-02 h	1.1E-02 i		0.10	4.1E+03	Y	1.1E+03		1.1E+03	9.1E+01
o-Chlorotoluene		2.0E-02 i		2.0E-02 i	0.10	1.3E+09	N	1.0E+06		4.0E+02	1.7E+02
					0.10	5.6E+03	Y	5.1E+02	3.6E+03		9.8E+02
											1.6E+02

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Chemical Name	SFo 1/(mg/kg-d)	RfDo (mg/kg-d)	SF1 1/(mg/kg-d)	RfD1 (mg/kg-d)	ABS (unitless)	V/P/F (m ³ /kg)	Volatile	SAT (mg/kg)	CARCINOGENICITY		SYSTEMIC TOXICITY	
									Residential (mg/kg)	Non-Residential (mg/kg)	Residential (mg/kg)	Non-Residential (mg/kg)
Chloropham	2.0E-01 i	2.0E-01 r	2.0E-01 i	2.0E-01 r	0.10	1.3E+09	N	1.0E+06			1.3E+04	1.4E+05
Chlorpyrifos	3.0E-03 i	3.0E-03 r	3.0E-03 i	3.0E-03 r	0.10	1.3E+09	N	1.0E+06			2.0E+02	2.0E+03
Chlorpyrifos-methyl	1.0E-02 h	1.0E-02 r	1.0E-02 i	1.0E-02 r	0.10	1.3E+09	N	1.0E+06			6.5E+02	6.8E+03
Chlorosulfuron	5.0E-02 i	5.0E-02 r	5.0E-02 i	5.0E-02 r	0.10	1.3E+09	N	1.0E+06			3.3E+03	3.4E+04
Chlorthionphos	8.0E-04 h	8.0E-04 r	8.0E-04 i	8.0E-04 r	0.10	1.3E+09	N	1.0E+06			5.2E+01	5.5E+02
Total Chromium (1/6 ratio Cr VI/Cr III)			4.2E+01 i		0.01	1.3E+09	N	1.0E+06	2.1E+03	4.5E+03	0.0E+00	0.0E+00
Chromium III	1.0E+00 i	1.0E+00 r	1.0E+00 i	1.0E+00 r	0.01	1.3E+09	N	1.0E+06			7.7E+04	1.7E+06
Chromium VI	5.0E-03 i	5.0E-03 r	2.9E+02 i	5.0E-03 r	0.01	1.3E+09	N	1.0E+06	3.0E+01	6.4E+01	3.8E+02	8.5E+03
Cobalt	6.0E-02 h	2.9E-04 r	2.9E-04 i	2.9E-04 r	0.01	1.3E+09	N	1.0E+06			4.6E+03	9.7E+04
Copper and compounds	3.7E-02 h	3.7E-02 r	3.7E-02 i	3.7E-02 r	0.01	1.3E+09	N	1.0E+06			2.8E+03	6.3E+04
Crotonaldehyde	1.9E+00 h	1.0E-02 x	1.9E+00 x	1.0E-02 r	0.10	1.3E+03	Y	1.4E+02	5.2E-02	1.1E-01	2.3E+01	7.7E+01
Cumene	4.0E-02 i	2.6E-03 h	2.6E-03 i	2.6E-03 r	0.10	4.7E+03	Y	2.2E+02			1.9E+01	6.2E+01
Cyanazine	8.4E-01 h	2.0E-03 h	8.4E-01 r	2.0E-03 r	0.10	1.3E+09	N	1.0E+06	5.3E+00	2.3E+01	1.3E+02	1.4E+03
Cyanides												
Barium cyanide	1.0E-01 h	1.0E-01 r	1.0E-01 i	1.0E-01 r	0.01	1.3E+09	N	1.0E+06			7.7E+03	1.7E+05
Calcium cyanide	4.0E-02 i	4.0E-02 r	4.0E-02 i	4.0E-02 r	0.01	1.3E+09	N	1.0E+06			3.1E+03	6.8E+04
Chlorine cyanide	5.0E-02 i	5.0E-02 r	5.0E-02 i	5.0E-02 r	0.01	1.3E+09	N	1.0E+06			3.8E+03	8.5E+04
Copper cyanide	5.0E-03 i	5.0E-03 r	5.0E-03 i	5.0E-03 r	0.01	1.3E+09	N	1.0E+06			3.8E+02	8.5E+03
Cyanogen	4.0E-02 i	4.0E-02 r	4.0E-02 i	4.0E-02 r	0.10	1.3E+09	N	1.0E+06			2.6E+03	2.7E+04
Cyanogen bromide	9.0E-02 i	9.0E-02 r	9.0E-02 i	9.0E-02 r	0.10	1.3E+09	N	1.0E+06			5.9E+03	6.1E+04
Cyanogen chloride	5.0E-02 i	5.0E-02 r	5.0E-02 i	5.0E-02 r	0.10	1.3E+09	N	1.0E+06			3.3E+03	3.4E+04
Free cyanide	2.0E-02 i	2.0E-02 r	2.0E-02 i	2.0E-02 r	0.10	1.3E+09	N	1.0E+06			1.3E+03	1.4E+04
Hydrogen cyanide	2.0E-02 i	8.6E-04 i	8.6E-04 i	8.6E-04 r	0.10	8.1E+03	Y	2.1E+05			1.1E+01	3.5E+01
Potassium cyanide	5.0E-02 i	5.0E-02 r	5.0E-02 i	5.0E-02 r	0.10	1.3E+09	N	1.0E+06			3.3E+03	3.4E+04
Potassium silver cyanide	2.0E-01 i	2.0E-01 r	2.0E-01 i	2.0E-01 r	0.10	1.3E+09	N	1.0E+06			1.3E+04	1.4E+05
Silver cyanide	1.0E-01 i	1.0E-01 r	1.0E-01 i	1.0E-01 r	0.10	1.3E+09	N	1.0E+06			6.5E+03	6.8E+04
Sodium cyanide	4.0E-02 i	4.0E-02 r	4.0E-02 i	4.0E-02 r	0.10	1.3E+09	N	1.0E+06			2.6E+03	2.7E+04
Zinc cyanide	5.0E-02 i	5.0E-02 r	5.0E-02 i	5.0E-02 r	0.10	1.3E+09	N	1.0E+06			3.3E+03	3.4E+04
Cyclohexanone	5.0E+00 i	5.0E+00 r	5.0E+00 i	5.0E+00 r	0.10	1.3E+09	N	1.0E+06			3.3E+05	3.4E+06
Cyclohexylamine	2.0E-01 i	2.0E-01 r	2.0E-01 i	2.0E-01 r	0.10	1.3E+09	N	1.0E+06			1.3E+04	1.4E+05
Cyhalothrin/Karate	5.0E-03 i	5.0E-03 r	5.0E-03 i	5.0E-03 r	0.10	1.3E+09	N	1.0E+06			3.3E+02	3.4E+03
Cypermethrin	1.0E-02 i	1.0E-02 r	1.0E-02 i	1.0E-02 r	0.10	1.3E+09	N	1.0E+06			6.5E+02	6.8E+03
Cyromazine	7.5E-03 i	7.5E-03 r	7.5E-03 i	7.5E-03 r	0.10	1.3E+09	N	1.0E+06			4.9E+02	5.1E+03
Daclathal	1.0E-02 i	1.0E-02 r	1.0E-02 i	1.0E-02 r	0.10	1.3E+09	N	1.0E+06			6.5E+02	6.8E+03
Delapron	3.0E-02 i	3.0E-02 r	3.0E-02 i	3.0E-02 r	0.10	1.3E+09	N	1.0E+06			2.0E+03	2.0E+04
Danilol	2.5E-02 i	2.5E-02 r	2.5E-02 i	2.5E-02 r	0.10	1.3E+09	N	1.0E+06			1.6E+03	1.7E+04
DDD	2.4E-01 i	2.4E-01 r	2.4E-01 i	2.4E-01 r	0.10	1.3E+09	N	1.0E+06	1.9E+01	7.9E+01	0.0E+00	0.0E+00
DDE	3.4E-01 i	3.4E-01 r	3.4E-01 i	3.4E-01 r	0.10	1.3E+09	N	1.0E+06	1.3E+01	5.6E+01	0.0E+00	0.0E+00
DDT	3.4E-01 i	3.4E-01 r	3.4E-01 i	3.4E-01 r	0.10	1.3E+09	N	1.0E+06	1.3E+01	5.6E+01	3.3E+01	3.4E+02
Decabromodiphenyl ether	1.0E-02 i	1.0E-02 r	1.0E-02 i	1.0E-02 r	0.10	1.3E+09	N	1.0E+06			6.5E+02	6.8E+03

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Chemical Name	SFO 1/(mg/kg-d)	RIDo (mg/kg-d)	SFI 1/(mg/kg-d)	RDI (mg/kg-d)	ABS (unitless)	VF/PEF (m ³ /kg)	Volatile	SAT (mg/kg)	1% EP (mg/kg)	CARCINOGENICITY		SYSTEMIC TOXICITY	
										Residential (mg/kg)	Non-Residential (mg/kg)	Residential (mg/kg)	Non-Residential (mg/kg)
Demeton	6.1E-02 h	4.0E-03 i	6.1E-02 r	4.0E-03 r	0.10	1.3E+09	N	1.0E+06		7.3E+01	3.1E+02	2.6E+00	2.7E+01
Diallate					0.10	1.3E+09	N	1.0E+06				0.0E+00	0.0E+00
Diazinon		9.0E-04 r		9.0E-04 r	0.10	1.3E+09	N	1.0E+06				5.9E+01	6.1E+02
Dibenzofuran		4.0E-03 n		4.0E-03 r	0.10	1.3E+09	N	1.0E+06				2.6E+02	2.7E+03
1,4-Dibromobenzene		1.0E-02 i		1.0E-02 r	0.10	1.3E+09	N	1.0E+06				6.3E+02	6.8E+03
Dibromochloromethane	8.4E-02 i	2.0E-02 i	8.4E-02 r	2.0E-02 r	0.10	1.3E+09	N	1.0E+06		5.3E+01	2.3E+02	1.3E+03	1.4E+04
1,2-Dibromo-3-chloropropane	1.4E+00 h	5.7E-03 h	2.4E-03 h	5.7E-03 i	0.10	1.3E+09	N	1.0E+06		3.2E+00	1.4E+01	3.7E+00	3.9E+01
1,2-Dibromochloroethane	8.5E+01 i	5.7E-05 f	7.7E-01 i	5.7E-05 h	0.10	9.2E+03	Y	9.2E+02		4.9E-02	2.0E-01	6.7E-01	2.3E+00
Dibutyl phthalate		1.0E-01 i		1.0E-01 r	0.10	1.3E+09	N	1.0E+06				6.5E+03	6.8E+04
Dicamba		3.0E-02 i		3.0E-02 r	0.10	1.3E+09	N	1.0E+06				2.0E+03	2.0E+04
1,2-Dichlorobenzene		9.0E-02 i		5.7E-02 h	0.10	1.4E+04	Y	7.0E+02	4.4E+03			1.1E+03	3.9E+03
1,3-Dichlorobenzene		3.0E-02 n		3.0E-02 r	0.10	1.4E+04	Y	8.6E+02	4.6E+03			5.0E+02	2.0E+03
1,4-Dichlorobenzene	2.4E-02 h	2.3E-01 i	2.4E-02 r	2.3E-01 i	0.10	1.3E+09	N	1.0E+06		1.9E+02	7.9E+02	1.5E+04	1.6E+05
3,3-Dichlorobenzidine	4.5E-01 i		4.5E-01 r		0.10	1.3E+09	N	1.0E+06		9.9E+00	4.2E+01	0.0E+00	0.0E+00
1,4-Dichloro-2-butene	9.3E+00 r		9.3E+00 h		0.10	1.2E+04	Y	1.1E+03		7.4E-02	1.7E-01	0.0E+00	0.0E+00
Dichlorodifluoromethane		2.0E-01 i		5.7E-02 h	0.10	1.1E+03	Y	3.4E+02				9.4E+01	3.1E+02
1,1-Dichloroethane		1.0E-01 h		1.4E-01 h	0.10	2.7E+03	Y	3.3E+03				5.0E+02	1.7E+03
1,2-Dichloroethane (EDC)	9.1E-02 i	2.9E-03 f	9.1E-02 i	2.9E-03 n	0.10	3.6E+03	Y	1.7E+03		2.3E+00	5.5E+00	1.5E+01	5.1E+01
1,1-Dichloroethylene	6.0E-01 i	9.0E-03 i	1.8E-01 i	9.0E-03 r	0.10	1.0E+03	Y	6.7E+02		3.6E-01	8.0E-01	1.4E+01	4.6E+01
1,2-Dichloroethylene (cis)		1.0E-02 h		1.0E-02 r	0.10	2.1E+03	Y	1.2E+03				3.1E+01	1.0E+02
1,2-Dichloroethylene (trans)		2.0E-02 i		2.0E-02 r	0.10	2.7E+03	Y	3.2E+03				7.8E+01	2.7E+02
1,2-Dichloroethylene (mixture)		9.0E-03 h		9.0E-03 r	0.10	2.7E+03	Y	3.2E+03				3.5E+01	1.2E+02
2,4-Dichlorophenol		3.0E-03 i		3.0E-03 r	0.10	1.3E+09	N	1.0E+06				2.0E+02	2.0E+03
4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)		8.0E-03 i		8.0E-03 r	0.10	1.3E+09	N	1.0E+06				5.2E+02	5.5E+03
2,4-Dichlorophenoxyacetic Acid (2,4-D)		1.0E-02 i		1.0E-02 r	0.10	1.3E+09	N	1.0E+06				6.5E+02	6.8E+03
1,2-Dichloropropane	6.8E-02 h	1.1E-03 f	6.8E-02 r	1.1E-03 i	0.10	3.3E+03	Y	1.2E+03		3.1E+00	6.8E+00	5.5E+00	1.9E+01
1,3-Dichloropropane	1.8E-01 h	3.0E-04 i	1.3E-01 h	5.7E-03 i	0.10	5.3E+03	Y	1.1E+03		2.4E+00	5.5E+00	1.4E+01	8.8E+01
2,3-Dichloropropanol		3.0E-03 i		3.0E-03 r	0.10	1.3E+09	N	1.0E+06				2.0E+02	2.0E+03
Dichlorvos	2.9E-01 i	5.0E-04 i	2.9E-01 r	1.4E-04 i	0.10	1.3E+09	N	1.0E+06		1.5E+01	6.6E+01	3.3E+01	3.4E+02
Dicofol	4.4E-01 x		4.4E-01 r		0.10	1.3E+09	N	1.0E+06		1.0E+01	4.3E+01	0.0E+00	0.0E+00
Diethin	1.6E+01 i	5.0E-05 i	1.6E+01 i	5.0E-05 r	0.10	1.3E+09	N	1.0E+06		2.8E-01	1.2E+00	3.3E+00	3.4E+01
Diethylene glycol, monobutyl ether		5.7E-03 h		5.7E-03 x	0.10	1.3E+09	N	1.0E+06				3.7E+02	3.9E+03
Diethylene glycol, monoethyl ether		2.0E+00 h		2.0E+00 r	0.10	1.3E+09	N	1.0E+06				1.3E+05	1.4E+06
Diethylformamide		1.1E-02 h		1.1E-02 r	0.10	1.3E+09	N	1.0E+06				7.2E+02	7.5E+03
Di(2-ethylhexyl)adipate	1.2E-03 i	6.0E-01 i	1.2E-03 r	6.0E-01 r	0.10	1.3E+09	N	1.0E+06		3.7E+03	1.6E+04	3.9E+04	4.1E+05
Diethyl phthalate		8.0E-01 i		8.0E-01 r	0.10	1.3E+09	N	1.0E+06				5.2E+04	5.5E+05
Diethylstilbestrol			4.7E+03 r		0.10	1.3E+09	N	1.0E+06		9.5E-05	4.1E-04	0.0E+00	0.0E+00
Difenoquat (Avenge)		8.0E-02 i		8.0E-02 r	0.10	1.3E+09	N	1.0E+06				5.2E+03	5.5E+04
Diflufenazon		2.0E-02 i		2.0E-02 r	0.10	1.3E+09	N	1.0E+06				1.3E+03	1.4E+04
Disopropyl methylphosphonate		8.0E-02 i		8.0E-02 r	0.10	1.3E+09	N	1.0E+06				5.2E+03	5.5E+04

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Chemical Name	SFO 1/(mg/kg-d)	RfD (mg/kg-d)	SFI 1/(mg/kg-d)	RDI (mg/kg-d)	ABS (unitless)	VF/PF (m ² /kg)	Volatile	SAT (mg/kg)	CARCINOGENICITY		SYSTEMIC TOXICITY	
									Residential	Non-Residential	Residential	Non-Residential
									(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Dimethipin		2.0E-02 i		2.0E-02 i	0.10	1.3E+09	N	1.0E+06			1.3E+03	1.4E+04
Dimethothate		2.0E-04 i		2.0E-04 i	0.10	1.3E+09	N	1.0E+06			1.3E+01	1.4E+02
3,3'-Dimethoxybenzidine	1.4E-02 h		1.4E-02 i		0.10	1.3E+09	N	1.0E+06	3.2E+02	1.4E+03	0.0E+00	0.0E+00
Dimethylamine		5.7E-06 i		5.7E-06 i	0.10	8.8E+03	Y	1.1E+05			6.5E-02	2.4E-01
N,N-Dimethylaniline		2.0E-03 i		2.0E-03 i	0.10	1.3E+09	N	1.0E+06			1.3E+02	1.4E+03
2,4-Dimethylaniline	7.5E-01 h		7.5E-01 i		0.10	1.3E+09	N	1.0E+06	5.9E+00	2.5E+01	0.0E+00	0.0E+00
2,4-Dimethylamine hydrochloride	5.8E-01 h		5.8E-01 i		0.10	1.3E+09	N	1.0E+06	7.7E+00	3.3E+01	0.0E+00	0.0E+00
3,3'-Dimethylbenzidine	9.2E+00 h		9.2E+00 i		0.10	1.3E+09	N	1.0E+06	4.8E-01	2.1E+00	0.0E+00	0.0E+00
1,1-Dimethylhydrazine	2.6E+00 x		3.5E+00 x		0.10	1.3E+09	N	1.0E+06	1.7E+00	7.3E+00	0.0E+00	0.0E+00
1,2-Dimethylhydrazine	3.7E+01 x		3.7E+01 x		0.10	1.3E+09	N	1.0E+06	1.2E-01	5.2E-01	0.0E+00	0.0E+00
N,N-Dimethylformamide		1.0E-01 h		8.6E-03 i	0.10	1.3E+09	N	1.0E+06			6.5E+03	6.8E+04
2,4-Dimethylphenol		2.0E-02 i		2.0E-02 i	0.10	1.3E+09	N	1.0E+06			1.3E+03	1.4E+04
2,6-Dimethylphenol		6.0E-04 i		6.0E-04 i	0.10	1.3E+09	N	1.0E+06			3.9E+01	4.1E+02
3,4-Dimethylphenol		1.0E-03 i		1.0E-03 i	0.10	1.3E+09	N	1.0E+06			6.5E+01	6.8E+02
Dimethyl phthalate		1.0E-01 h		1.0E-01 i	0.10	1.3E+09	N	1.0E+06			6.5E+05	6.8E+06
Dimethyl terphenylate		1.0E-01 i		1.0E-01 i	0.10	1.3E+09	N	1.0E+06			6.5E+03	6.8E+04
4,6-Dinitro-o-cyclohexyl phenol		2.0E-03 i		2.0E-03 i	0.10	1.3E+09	N	1.0E+06			1.3E+02	1.4E+03
1,3-Dinitrobenzene		1.0E-04 i		1.0E-04 i	0.10	1.3E+09	N	1.0E+06			6.5E+00	6.8E+01
1,2-Dinitrobenzene		4.0E-04 h		4.0E-04 i	0.10	1.3E+09	N	1.0E+06			2.6E+01	2.7E+02
1,4-Dinitrobenzene		4.0E-04 h		4.0E-04 i	0.10	1.3E+09	N	1.0E+06			2.6E+01	2.7E+02
2,4-Dinitrophenol		2.0E-03 i		2.0E-03 i	0.10	1.3E+09	N	1.0E+06			1.3E+02	1.4E+03
Dinitrotoluene mixture	6.8E-01 i		6.8E-01 i		0.10	1.3E+09	N	1.0E+06	6.5E+00	2.8E+01	0.0E+00	0.0E+00
2,4-Dinitrotoluene		2.0E-03 i		2.0E-03 i	0.10	1.3E+09	N	1.0E+06			1.3E+02	1.4E+03
2,6-Dinitrotoluene		1.0E-03 h		1.0E-03 i	0.10	1.3E+09	N	1.0E+06			6.5E+01	6.8E+02
Dinitrobenz		1.0E-03 i		1.0E-03 i	0.10	1.3E+09	N	1.0E+06			6.5E+01	6.8E+02
di-n-Octyl phthalate		2.0E-02 h		2.0E-02 i	0.10	1.3E+09	N	1.0E+06			1.3E+03	1.4E+04
1,4-Dioxane	1.1E-02 i		1.1E-02 i		0.10	1.3E+09	N	1.0E+06	4.0E-02	1.7E+03	0.0E+00	0.0E+00
Diphenamid		3.0E-02 i		3.0E-02 i	0.10	1.3E+09	N	1.0E+06			2.0E+03	2.0E+04
Diphenylamine		2.5E-02 i		2.5E-02 i	0.10	1.3E+09	N	1.0E+06			1.6E+03	1.7E+04
1,2-Diphenylhydrazine	8.0E-01 i		7.7E-01 i		0.10	1.3E+09	N	1.0E+06	5.6E+00	2.4E+01	0.0E+00	0.0E+00
Diquat		2.2E-03 i		2.2E-03 i	0.10	1.3E+09	N	1.0E+06			1.4E+02	1.5E+03
Direct black 38	8.6E+00 h		8.6E+00 i		0.10	1.3E+09	N	1.0E+06	5.2E-02	2.2E-01	0.0E+00	0.0E+00
Direct blue 6	8.1E+00 h		8.1E+00 i		0.10	1.3E+09	N	1.0E+06	5.5E-02	2.4E-01	0.0E+00	0.0E+00
Direct brown 95	9.3E+00 h		9.3E+00 i		0.10	1.3E+09	N	1.0E+06	4.8E-02	2.1E-01	0.0E+00	0.0E+00
Disulfoton		4.0E-05 i		4.0E-05 i	0.10	1.3E+09	N	1.0E+06			2.6E+00	2.7E+01
1,4-Dibutane		1.0E-02 i		1.0E-02 i	0.10	1.3E+09	N	1.0E+06			6.3E+02	6.8E+03
Duon		2.0E-03 i		2.0E-03 i	0.10	1.3E+09	N	1.0E+06			1.3E+02	1.4E+03
Dodine		4.0E-03 i		4.0E-03 i	0.10	1.3E+09	N	1.0E+06			2.6E+02	2.7E+03
Endosulfan		6.0E-03 i		6.0E-03 i	0.10	1.3E+09	N	1.0E+06			3.9E+02	4.1E+03
Endothall		2.0E-02 i		2.0E-02 i	0.10	1.3E+09	N	1.0E+06			1.3E+03	1.4E+04

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Chemical Name	SFO 1/(mg/kg-d)	RfD _o (mg/kg-d)	SFI 1/(mg/kg-d)	RfD _i (mg/kg-d)	ABS (unitless)	VF/PEF (m ² /kg)	Volatile	SAT (mg/kg)	CARCINOGENICITY		SYSTEMIC TOXICITY	
									Residential (mg/kg)	Non-Residential (mg/kg)	Residential (mg/kg)	Non-Residential (mg/kg)
Endrin												
Epichlorohydrin	9.0E-03 i	3.0E-04 i	4.2E-03 i	3.0E-04 i	0.10	1.3E+09	N	1.0E+06	1.7E+02	4.6E+02	2.0E+01	2.0E+02
1,2-Epoxybutane	5.7E-03 f	2.0E-03 h	5.7E-03 f	2.9E-04 i	0.10	1.8E+04	Y	7.3E+03			7.3E+00	2.3E+01
EPTC (S-Ethyl dipropylthiocarbamate)	2.3E-02 i	5.0E-03 i	5.0E-03 i	5.7E-03 i	0.10	1.3E+09	N	1.0E+06			3.7E+02	3.9E+03
Phosphon (2-chloroethyl phosphonic acid)	5.0E-03 i	5.0E-03 i	5.0E-03 i	5.0E-03 i	0.10	1.3E+09	N	1.0E+06			1.6E+03	1.7E+04
Ethion	5.0E-04 i	5.0E-04 i	5.0E-04 i	5.0E-04 i	0.10	1.3E+09	N	1.0E+06			3.3E+02	3.4E+03
2-Ethoxyethanol	4.0E-01 h	4.0E-01 h	4.0E-01 h	5.7E-02 i	0.10	1.3E+09	N	1.0E+06			3.3E+01	3.4E+02
2-Ethoxyethanol acetate	3.0E-01 h	3.0E-01 h	3.0E-01 h	3.0E-01 i	0.10	1.3E+09	N	1.0E+06			2.6E+04	2.7E+05
Ethyl acetate	9.0E-01 i	9.0E-01 i	9.0E-01 i	9.0E-01 i	0.10	1.8E+04	Y	3.7E+04	3.9E+04		2.0E+04	2.0E+05
Ethyl acrylate	4.8E-02 h	4.8E-02 i	4.8E-02 i	4.8E-02 i	0.10	1.5E+03	Y	1.4E+02	2.1E+00	4.3E+00	1.9E+04	7.3E+04
Ethylbenzene	1.0E-01 i	1.0E-01 i	1.0E-01 i	2.9E-01 i	0.10	4.3E+03	Y	2.3E+02			1.5E+03	5.8E+03
Ethylene cyanohydrin	3.0E-01 h	3.0E-01 h	3.0E-01 h	3.0E-01 i	0.10	1.3E+09	N	1.0E+06			2.0E+04	2.0E+05
Ethylene diamine	2.0E-02 h	2.0E-02 h	2.0E-02 h	2.0E-02 i	0.10	1.3E+09	N	1.0E+06			1.3E+03	1.4E+04
Ethylene glycol	2.0E+00 i	2.0E+00 i	2.0E+00 i	2.0E+00 i	0.10	1.3E+09	N	1.0E+06			1.3E+03	1.4E+06
Ethylene glycol monobutyl ether	5.7E-03 f	5.7E-03 f	5.7E-03 f	5.7E-03 h	0.10	1.3E+09	N	1.0E+06			3.7E+02	3.9E+03
Ethylene oxide	1.0E+00 h	1.0E+00 h	3.5E-01 h	3.5E-01 h	0.10	9.4E+03	Y	1.1E+05	1.3E+00	3.2E+00	0.0E+00	0.0E+00
Ethylene thiourea (ETU)	1.1E-01 h	8.0E-05 i	1.1E-01 i	8.0E-05 i	0.10	1.3E+09	N	1.0E+06	4.0E-01	1.7E+02	5.2E+00	5.3E+01
Ethyl chloride	2.0E-02 n	2.9E+00 i	2.9E+00 i	2.9E+00 i	0.10	1.3E+03	Y	1.6E+03			1.1E+03	8.0E+03
Ethyl ether	2.0E-01 i	2.0E-01 i	2.0E-01 i	2.0E-01 i	0.10	3.8E+04	Y	1.8E+03			6.2E+03	3.0E+04
Ethyl methacrylate	9.0E-02 h	9.0E-02 h	9.0E-02 h	9.0E-02 i	0.10	1.5E+03	Y	1.4E+02			2.1E+02	6.9E+02
Ethyl p-nitrophenyl phenylphosphorothioate	1.0E-03 i	1.0E-03 i	1.0E-03 i	1.0E-03 i	0.10	1.3E+09	N	1.0E+06			6.3E-01	6.8E+00
Ethylphthalyl ethyl glycolate	3.0E+00 i	3.0E+00 i	3.0E+00 i	3.0E+00 i	0.10	1.3E+09	N	1.0E+06			2.0E+05	2.0E+06
Express	8.0E-03 i	8.0E-03 i	8.0E-03 i	8.0E-03 i	0.10	1.3E+09	N	1.0E+06			5.2E+02	5.3E+03
Penamphos	2.5E-04 i	2.5E-04 i	2.5E-04 i	2.5E-04 i	0.10	1.3E+09	N	1.0E+06			1.6E+01	1.7E+02
Fluometuon	1.3E-02 i	1.3E-02 i	1.3E-02 i	1.3E-02 i	0.10	1.3E+09	N	1.0E+06			8.3E+02	8.9E+03
Fluorine (soluble fluoride)	6.0E-02 i	6.0E-02 i	6.0E-02 i	6.0E-02 i	0.10	1.3E+09	N	1.0E+06			3.9E+03	4.1E+04
Fluoridone	8.0E-02 i	8.0E-02 i	8.0E-02 i	8.0E-02 i	0.10	1.3E+09	N	1.0E+06			5.2E+03	5.3E+04
Fluprimidol	2.0E-02 i	2.0E-02 i	2.0E-02 i	2.0E-02 i	0.10	1.3E+09	N	1.0E+06			1.3E+03	1.4E+04
Flutolanil	6.0E-02 i	6.0E-02 i	6.0E-02 i	6.0E-02 i	0.10	1.3E+09	N	1.0E+06			3.9E+03	4.1E+04
Fluxalinol	1.0E-02 i	1.0E-02 i	1.0E-02 i	1.0E-02 i	0.10	1.3E+09	N	1.0E+06			6.3E+02	6.8E+03
Folpet	3.3E-03 i	1.0E-01 i	3.3E-03 i	1.0E-01 i	0.10	1.3E+09	N	1.0E+06			1.3E+03	6.3E+03
Fomesafen	1.9E-01 i	1.9E-01 i	1.9E-01 i	1.9E-01 i	0.10	1.3E+09	N	1.0E+06			2.3E+01	6.8E+04
Fonofos	2.0E-03 i	2.0E-03 i	2.0E-03 i	2.0E-03 i	0.10	1.3E+09	N	1.0E+06			0.0E+00	0.0E+00
Formaldehyde	1.5E-01 i	1.5E-01 i	1.5E-01 i	1.5E-01 i	0.10	1.3E+09	N	1.0E+06			1.3E+02	1.4E+03
Formic Acid	2.0E+00 h	2.0E+00 h	2.0E+00 h	2.0E+00 i	0.10	1.3E+09	N	1.0E+06	1.9E+06	4.1E+06	9.8E+03	1.0E+05
Fosetyl-al	3.0E+00 i	3.0E+00 i	3.0E+00 i	3.0E+00 i	0.10	1.3E+09	N	1.0E+06			1.3E+03	1.3E+05
Furan	1.0E-03 i	1.0E-03 i	1.0E-03 i	1.0E-03 i	0.10	1.7E+03	Y	2.2E+03			2.0E+05	2.0E+06
Purazobidone	3.8E+00 h	3.8E+00 h	3.8E+00 h	3.8E+00 i	0.10	1.3E+09	N	1.0E+06	1.2E+00	5.0E+00	0.0E+00	0.0E+00
Furfural	3.0E-03 i	3.0E-03 i	3.0E-03 i	1.4E-02 h	0.10	1.3E+09	N	1.0E+06			2.0E+02	2.0E+03
Purium	5.0E+01 h	5.0E+01 h	5.0E+01 h	5.0E+01 i	0.10	1.3E+09	N	1.0E+06	8.9E-02	3.8E-01	0.0E+00	0.0E+00

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Chemical Name	SFo 1/(mg/kg-d)	RfDo (mg/kg-d)	SFI 1/(mg/kg-d)	RfDI (mg/kg-d)	ABS (unit/kg)	VF/PEF (mg/kg)	Volatile (mg/kg)	SAT (mg/kg)	1% RP (mg/kg)	CARCINOGENICITY		SYSTEMIC TOXICITY	
										Residential (mg/kg)	Non-Residential (mg/kg)	Residential (mg/kg)	Non-Residential (mg/kg)
Fumarylchloride	3.0E-02 i	4.0E-04 i	3.0E-02 i	4.0E-04 i	0.10	1.3E+09	N	1.0E+06		1.5E+02	6.4E+02	0.0E+00	0.0E+00
Glycidol	4.5E+00 i	4.0E-04 i	4.6E+00 i	5.0E-04 i	0.10	1.3E+09	N	1.0E+06		9.9E-01	4.2E+00	2.6E+01	2.7E+02
Glycidol epoxide	9.1E+00 i	1.3E-05 i	9.1E+00 i	1.3E-05 i	0.10	1.3E+09	N	1.0E+06		4.9E-01	2.1E+00	2.6E+01	2.7E+02
Hexachlorobenzene	1.6E+00 i	2.0E-03 i	1.6E+00 i	2.0E-03 i	0.10	1.3E+09	N	1.0E+06		2.8E+00	1.2E+01	3.3E+00	6.8E+04
Hexachlorocyclopentadiene	7.8E-02 i	2.0E-04 h	7.7E-02 i	2.0E-04 i	0.10	1.3E+09	N	1.0E+06		5.7E+01	2.4E+02	8.5E+02	3.4E+01
HCH (alpha)	6.3E+00 i	1.0E-03 i	6.3E+00 i	1.0E-03 i	0.10	1.3E+09	N	1.0E+06		7.1E-01	3.0E+00	3.3E+01	3.4E+02
HCH (beta)	1.8E+00 i	3.0E-04 i	1.8E+00 i	3.0E-04 i	0.10	1.3E+09	N	1.0E+06		2.5E+00	1.1E+01	8.5E+01	8.9E+00
HCH (gamma) Lindane	1.3E+00 h	3.0E-04 i	1.3E+00 i	3.0E-04 i	0.10	1.3E+09	N	1.0E+06		3.4E+00	1.5E+01	1.3E+02	1.4E+03
HCH (technical)	1.8E+00 i	1.8E-03 i	1.8E+00 i	1.8E-03 i	0.10	1.3E+09	N	1.0E+06		2.5E+00	1.1E+01	0.0E+00	0.0E+00
Hexachlorocyclopentadiene	6.2E+03 i	7.0E-03 i	4.6E+03 i	2.0E-05 h	0.10	1.3E+09	N	1.0E+06		7.2E-04	3.1E-03	0.0E+00	4.6E+03
Hexachlorodibenzo-p-dioxin mixture (HxCDD)	1.4E-02 i	1.0E-03 i	1.4E-02 i	1.0E-03 i	0.10	1.3E+09	N	1.0E+06		3.2E-02	1.4E+03	6.5E+01	6.8E+02
Hexachloroethane	1.1E-01 i	3.0E-04 i	1.1E-01 i	3.0E-04 i	0.10	1.3E+09	N	1.0E+06		4.0E+01	1.7E+02	2.0E+01	2.0E+02
Hexachlorophene	3.0E+00 i	6.0E-02 h	1.7E+01 i	5.7E-02 i	0.10	1.4E+03	Y	1.1E+02	2.0E+03	1.2E+02	2.2E+03	4.0E+02	4.0E+02
Hexahydro-1,3,5-trinitro-1,3,5-triazine	1.1E-03 j	3.3E-02 i	1.1E-03 j	3.3E-02 i	0.10	1.3E+09	N	1.0E+06		1.5E+00	6.4E+00	0.0E+00	0.0E+00
n-Hexane	1.1E-03 j	5.7E-03 i	1.1E-03 j	5.7E-03 i	0.01	1.3E+09	N	1.0E+06		4.1E+03	1.8E+04	0.0E+00	0.0E+00
Hydrazine, hydrazine sulfate													
Hydrocarbons (C10 to C14)													
Hydrogen chloride													
p-Hydroquinone													
Imazalil													
Imazaquin													
Iprodione													
Isobutanol													
Isophorone													
Isopropalin													
Isopropyl methyl phosphonic acid													
Isoxaben													
Kepon													
Lactofen													
Lead													
Lead (tetramethyl)													
Lisuron													

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										Residential (mg/kg)	Non-Residential (mg/kg)	Residential (mg/kg)	Non-Residential (mg/kg)
Lithium		2.0E-02 n		2.0E-02 r	0.01	1.3E+09	N	1.0E+06				1.3E+03	3.4E+04
Londax		2.0E-01 i		2.0E-01 r	0.10	1.3E+09	N	1.0E+06				1.3E+04	1.4E+05
Malathion		2.0E-02 i		2.0E-02 r	0.10	1.3E+09	N	1.0E+06				1.3E+03	1.4E+04
Maleic anhydride		1.0E-01 i		1.0E-01 r	0.10	1.3E+09	N	1.0E+06				6.3E+03	6.8E+04
Maleic hydrazide		5.0E-01 i		5.0E-01 r	0.10	1.3E+09	N	1.0E+06				3.3E+04	3.4E+05
Malononitrile		2.0E-05 h		2.0E-05 r	0.10	1.3E+09	N	1.0E+06				1.3E+00	1.4E+01
Mancosb		3.0E-02 h		3.0E-02 r	0.10	1.3E+09	N	1.0E+06				2.0E+03	2.0E+04
Mameb		5.0E-03 i		5.0E-03 r	0.10	1.3E+09	N	1.0E+06				3.3E+02	3.4E+03
Manganese and compounds		4.7E-02 i		1.4E-03 i	0.01	1.3E+09	N	1.0E+06				3.2E+03	4.3E+04
Mepiostolan		9.0E-05 h		9.0E-05 r	0.10	1.3E+09	N	1.0E+06				5.9E+00	6.1E+01
Mepiquat		3.0E-02 i		3.0E-02 r	0.10	1.3E+09	N	1.0E+06				2.0E+03	2.0E+04
Mercuric chloride		3.0E-04 i		3.0E-04 r	0.01	1.3E+09	N	1.0E+06				2.3E+01	5.1E+02
Mercury (elemental)		8.6E-05 r		8.6E-05 i	0.01	1.3E+09	N	1.0E+06				6.7E+00	1.8E+02
Mercury (methyl)		1.0E-04 i		1.0E-04 r	0.10	1.3E+09	N	1.0E+06				6.3E+00	6.8E+01
Merphos		3.0E-05 i		3.0E-05 r	0.10	1.3E+09	N	1.0E+06				2.0E+00	2.0E+01
Merphos oxide		3.0E-05 i		3.0E-05 r	0.10	1.3E+09	N	1.0E+06				2.0E+00	2.0E+01
Metolaxyl		6.0E-02 i		6.0E-02 r	0.10	1.3E+09	N	1.0E+06				3.9E+03	4.1E+04
Methoxytoluene		1.0E-04 i		2.0E-04 h	0.10	8.9E+03	Y	8.4E+03				2.0E+00	8.1E+00
Methamidophos		5.0E-05 i		5.0E-05 r	0.10	1.3E+09	N	1.0E+06				3.3E+00	3.4E+01
Methanol		5.0E-01 i		5.0E-01 r	0.10	1.3E+09	N	1.0E+06				3.3E+04	3.4E+05
Methidathion		1.0E-03 i		1.0E-03 r	0.10	1.3E+09	N	1.0E+06				6.3E+01	6.8E+02
Methomyl		2.5E-02 i		2.5E-02 r	0.10	1.3E+09	N	1.0E+06				1.6E+03	1.7E+04
Methoxychlor		5.0E-03 i		5.0E-03 r	0.10	1.3E+09	N	1.0E+06				3.3E+02	3.4E+03
2-Methoxyethanol		1.0E-03 h		5.7E-03 i	0.10	1.3E+09	N	1.0E+06				6.3E+01	6.8E+02
2-Methoxyethanol acetate		2.0E-03 h		2.0E-03 r	0.10	1.3E+09	N	1.0E+06				1.3E+02	1.4E+03
2-Methoxy-5-nitroaniline		4.6E-02 h		4.6E-02 r	0.10	1.3E+09	N	1.0E+06		9.7E+01	4.1E+02	0.0E+00	0.0E+00
Methyl acetate		1.0E+00 h		1.0E+00 r	0.10	2.0E+04	Y	1.1E+05				2.1E+04	8.8E+04
Methyl acrylate		3.0E-02 h		3.0E-02 r	0.10	1.5E+03	Y	4.2E+02				6.9E+01	2.3E+02
2-Methyl-4-chlorophenoxy (o-toluidine)		2.4E-01 h		2.4E-01 r	0.10	1.3E+09	N	1.0E+06		1.9E+01	7.9E+01	0.0E+00	0.0E+00
2-Methyl-4-chlorophenoxy hydrochloride		1.8E-01 h		1.8E-01 r	0.10	1.3E+09	N	1.0E+06		2.5E+01	1.1E+02	0.0E+00	0.0E+00
Methyl chloroacetate		1.0E+00 x		1.0E+00 r	0.10	1.3E+09	N	1.0E+06				6.3E+04	6.8E+05
2-Methyl-4-chlorophenoxyacetic acid		5.0E-04 i		5.0E-04 r	0.10	1.3E+09	N	1.0E+06				3.3E+01	3.4E+02
4-(2-Methyl-4-chlorophenoxy) butyric acid (MCPB)		1.0E-02 i		1.0E-02 r	0.10	1.3E+09	N	1.0E+06				6.3E+02	6.8E+03
2-(2-Methyl-4-chlorophenoxy) propionic acid		1.0E-03 i		1.0E-03 r	0.10	1.3E+09	N	1.0E+06				6.3E+01	6.8E+02
2-(2-Methyl-4-chlorophenoxy) propionic acid (MCPFP)		1.0E-03 i		1.0E-03 r	0.10	1.3E+09	N	1.0E+06				6.3E+01	6.8E+02
Methylcyclohexane		8.6E-01 r		8.6E-01 h	0.10	1.3E+09	N	1.0E+06				5.6E+04	5.9E+05
4,4'-Methylenebisbenzotriazine		2.5E-01 h		2.5E-01 r	0.10	1.3E+09	N	1.0E+06		1.8E+01	7.6E+01	0.0E+00	0.0E+00
4,4'-Methylene bis(2-chloroaniline)		1.3E-01 h		1.3E-01 h	0.10	1.3E+09	N	1.0E+06		3.4E+01	1.5E+02	4.6E+01	4.8E+02
4,4'-Methylene bis(N,N'-dimethylaniline)		4.6E-02 i		4.6E-02 r	0.10	1.3E+09	N	1.0E+06		9.7E+01	4.1E+02	0.0E+00	0.0E+00
Methylene bromide		1.0E-02 h		1.0E-02 r	0.10	1.3E+09	N	1.0E+06				6.3E+02	6.8E+03

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										Residential (mg/kg)	Non-Residential (mg/kg)	Residential (mg/kg)	Non-Residential (mg/kg)
Methylene chloride	7.5E-03 i	6.0E-02 i	1.6E-03 i	8.6E-01 h	0.10	2.2E+03	Y	2.3E+03		7.7E+01	1.8E+02	1.7E+03	7.8E+03
Methyl ethyl ketone		6.0E-01 i		2.9E-01 i	0.10	1.9E+04	Y	3.4E+04				7.1E+03	2.7E+04
Methyl hydrazine	1.1E+00 h		1.1E+00 r		0.10	1.3E+09	N	1.0E+06		4.0E+00	1.7E+01	0.0E+00	0.0E+00
Methyl isobutyl ketone		8.0E-02 h		2.3E-02 h	0.10	2.2E+04	Y	1.7E+04				7.7E+02	2.8E+03
Methyl methacrylate		8.0E-02 h		8.0E-02 r	0.10	7.1E+03	Y	2.7E+03	5.4E+03			7.6E+02	2.8E+03
2-Methyl-5-nitroaniline	3.3E-02 h		3.3E-02 r		0.10	1.3E+09	N	1.0E+06		1.3E+02	5.8E+02	0.0E+00	0.0E+00
Methyl parathion		2.5E-04 i		2.5E-04 r	0.10	1.3E+09	N	1.0E+06				1.6E+01	1.7E+02
2-Methylphenol		5.0E-02 x		5.0E-02 r	0.10	1.3E+09	N	1.0E+06				3.3E+03	3.4E+04
3-Methylphenol		5.0E-02 x		5.0E-02 r	0.10	1.3E+09	N	1.0E+06				3.3E+03	3.4E+04
4-Methylphenol		5.0E-03 h		5.0E-03 r	0.10	1.3E+09	N	1.0E+06				3.3E+02	3.4E+03
Methyl styrene (mixture)		6.0E-03 h		1.1E-02 h	0.10	1.0E+04	Y	6.8E+02				1.7E+02	5.2E+02
Methyl styrene (alpha)		7.0E-02 h		7.0E-02 r	0.10	1.0E+04	Y	6.8E+02	3.1E+03			8.9E+02	3.4E+03
Methyl tertbutyl ether (MTBE)		5.0E-03 n		8.6E-01 i	0.10	1.3E+09	N	1.0E+06				3.3E+02	3.4E+03
Metolacel (Dial)		1.5E-01 i		1.5E-01 r	0.10	1.3E+09	N	1.0E+06				9.8E+03	1.0E+05
Metribuzin		2.5E-02 i		2.5E-02 r	0.10	1.3E+09	N	1.0E+06				1.6E+03	1.7E+04
Mirex	1.8E+00 h	2.0E-04 i	1.8E+00 r	2.0E-04 r	0.10	1.3E+09	N	1.0E+06		2.5E+00	1.1E+01	1.3E+01	1.4E+02
Molinate		2.0E-03 i		2.0E-03 r	0.10	1.3E+09	N	1.0E+06				1.3E+02	1.4E+03
Molybdenum		5.0E-03 h		5.0E-03 r	0.01	1.3E+09	N	1.0E+06				3.8E+02	8.3E+03
Monochloramine		1.0E-01 h		1.0E-01 h	0.10	1.3E+09	N	1.0E+06				6.5E+03	6.8E+04
Naled		2.0E-03 i		2.0E-03 r	0.10	1.3E+09	N	1.0E+06				1.3E+02	1.4E+03
Nagropantide		1.0E-01 i		1.0E-01 r	0.10	1.3E+09	N	1.0E+06				6.5E+03	6.8E+04
Nickel and compounds		2.0E-02 i		2.0E-02 r	0.01	1.3E+09	N	1.0E+06				1.3E+03	3.4E+04
Nickel subsulfide			1.7E+00 i		0.01	1.3E+09	N	1.0E+06		5.1E+03	1.1E+04	0.0E+00	0.0E+00
Nitrophenol		1.5E-03 x		1.5E-03 r	0.10	1.3E+09	N	1.0E+06				9.8E+01	1.0E+03
Nitrate		1.6E+00 i		1.6E+00 r	0.10	1.3E+09	N	1.0E+06				1.0E+05	1.1E+06
Nitrite		1.0E-01 i		1.0E-01 r	0.10	1.3E+09	N	1.0E+06				6.5E+03	6.8E+04
2-Nitroaniline		6.0E-05 r		5.7E-05 h	0.10	1.3E+09	N	1.0E+06				3.9E+03	4.1E+01
Nitrobenzene		5.0E-04 i		5.7E-04 h	0.10	4.4E+04	Y	1.0E+03				1.8E+01	9.4E+01
Nitrofurantoin		7.0E-02 h		7.0E-02 r	0.10	1.3E+09	N	1.0E+06				4.6E+03	4.8E+04
Nitrofurazone	1.5E+00 h		9.4E+00 h		0.10	1.3E+09	N	1.0E+06		3.0E+00	1.3E+01	0.0E+00	0.0E+00
Nitroguanidine		1.0E-01 i		1.0E-01 r	0.10	1.3E+09	N	1.0E+06				6.5E+03	6.8E+04
N-Nitrosodimethylaniline	5.4E+00 i		5.6E+00 i		0.10	2.6E+04	Y	2.1E+03		2.2E-01	5.5E-01	0.0E+00	0.0E+00
N-Nitrosodiphenylamine	2.8E+00 i		2.8E+00 r		0.10	1.3E+09	N	1.0E+06		1.6E+00	6.8E+00	0.0E+00	0.0E+00
N-Nitrosodimethylaniline	1.5E+02 i		1.5E+02 i		0.10	1.3E+09	N	1.0E+06		3.0E-02	1.3E-01	0.0E+00	0.0E+00
N-Nitrosodiphenylamine	5.1E+01 i		4.9E+01 i		0.10	1.3E+09	N	1.0E+06		8.7E-02	3.7E-01	0.0E+00	0.0E+00
N-Nitrosodiphenylamine	4.9E-03 i		4.9E-03 r		0.10	1.3E+09	N	1.0E+06		9.1E-02	3.9E+03	0.0E+00	0.0E+00
N-Nitroso di-n-propylamine	7.0E+00 i		7.0E+00 r		0.10	1.3E+09	N	1.0E+06		6.3E-01	2.7E+00	0.0E+00	0.0E+00
N-Nitroso-N-methylamine	2.2E+01 i		2.2E+01 r		0.10	1.3E+09	N	1.0E+06		2.0E-01	8.7E-01	0.0E+00	0.0E+00

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Chemical Name	SFO 1/(mg/kg-d)	RfDo (mg/kg-d)	SFI 1/(mg/kg-d)	RfDI (mg/kg-d)	ABS (unitless)	VTEF (m ³ /kg)	Vol _{air}	SAT (mg/kg)	1% FP (mg/kg)	CARCINOGENICITY		SYSTEMIC TOXICITY	
										Residential	Non-Residential	Residential	Non-Residential
										(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
N-Nitrosopyrrolidine	2.1E+00 i	1.0E-02 i	2.1E+00 i	1.0E-02 i	0.10	1.3E+09	N	1.0E+06	2.1E+00	9.1E+00	0.0E+00	0.0E+00	0.0E+00
m-Nitrotoluene	1.0E-02 h	1.0E-02 i	1.0E-02 h	1.0E-02 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	6.5E+02	6.5E+02	6.5E+02	6.5E+02
p-Nitrotoluene	1.0E-02 h	1.0E-02 i	1.0E-02 h	1.0E-02 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	6.5E+02	6.5E+02	6.5E+02	6.5E+02
Nordiazon	4.0E-02 i	4.0E-02 i	4.0E-02 i	4.0E-02 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	2.6E+03	2.6E+03	2.6E+03	2.6E+03
NuStar	7.0E-04 i	7.0E-04 i	7.0E-04 i	7.0E-04 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	4.6E+01	4.6E+01	4.6E+01	4.6E+01
Octabromodiphenyl ether	3.0E-03 i	3.0E-03 i	3.0E-03 i	3.0E-03 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	2.0E+02	2.0E+02	2.0E+02	2.0E+02
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	5.0E-02 i	5.0E-02 i	5.0E-02 i	5.0E-02 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	3.3E+03	3.3E+03	3.3E+03	3.3E+03
Octamethylpyrophosphonamide	2.0E-03 h	2.0E-03 h	2.0E-03 h	2.0E-03 h	0.10	1.3E+09	N	1.0E+06	1.0E+06	1.3E+02	1.3E+02	1.3E+02	1.3E+02
Oryzalin	5.0E-02 i	5.0E-02 i	5.0E-02 i	5.0E-02 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	3.3E+03	3.3E+03	3.3E+03	3.3E+03
Oxydiazon	5.0E-03 i	5.0E-03 i	5.0E-03 i	5.0E-03 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	3.3E+02	3.3E+02	3.3E+02	3.3E+02
Oxamyl	2.5E-02 i	2.5E-02 i	2.5E-02 i	2.5E-02 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	1.6E+03	1.6E+03	1.6E+03	1.6E+03
Oxyfluorfen	3.0E-03 i	3.0E-03 i	3.0E-03 i	3.0E-03 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	2.0E+02	2.0E+02	2.0E+02	2.0E+02
Paclobutrazol	1.3E-02 i	1.3E-02 i	1.3E-02 i	1.3E-02 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	8.5E+02	8.5E+02	8.5E+02	8.5E+02
Paraquat	4.5E-03 i	4.5E-03 i	4.5E-03 i	4.5E-03 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	2.9E+02	2.9E+02	2.9E+02	2.9E+02
Parathion	6.0E-03 h	6.0E-03 h	6.0E-03 h	6.0E-03 h	0.10	1.3E+09	N	1.0E+06	1.0E+06	3.9E+02	3.9E+02	3.9E+02	3.9E+02
Pebulate	5.0E-02 h	5.0E-02 h	5.0E-02 h	5.0E-02 h	0.10	1.3E+09	N	1.0E+06	1.0E+06	3.3E+03	3.3E+03	3.3E+03	3.3E+03
Pendimethalin	4.0E-02 i	4.0E-02 i	4.0E-02 i	4.0E-02 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	2.6E+03	2.6E+03	2.6E+03	2.6E+03
Pentabromo-6-chloro cyclohexane	2.3E-02 h	2.3E-02 h	2.3E-02 h	2.3E-02 h	0.10	1.3E+09	N	1.0E+06	1.0E+06	8.3E+02	8.3E+02	8.3E+02	8.3E+02
Pentabromodiphenyl ether	2.0E-03 i	2.0E-03 i	2.0E-03 i	2.0E-03 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	1.3E+02	1.3E+02	1.3E+02	1.3E+02
Pentachlorobenzene	8.0E-04 i	8.0E-04 i	8.0E-04 i	8.0E-04 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	5.2E+01	5.2E+01	5.2E+01	5.2E+01
Pentachloronitrobenzene	3.0E-03 i	3.0E-03 i	3.0E-03 i	3.0E-03 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	7.3E+01	7.3E+01	7.3E+01	7.3E+01
Pentachloropentanol	1.2E-01 i	1.2E-01 i	1.2E-01 i	1.2E-01 i	0.25	1.3E+09	N	1.0E+06	1.0E+06	7.9E+01	7.9E+01	7.9E+01	7.9E+01
Pentachlorophenol	5.0E-02 i	5.0E-02 i	5.0E-02 i	5.0E-02 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	3.3E+03	3.3E+03	3.3E+03	3.3E+03
Pentachlorophenyl ether	2.5E-01 i	2.5E-01 i	2.5E-01 i	2.5E-01 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	1.6E+04	1.6E+04	1.6E+04	1.6E+04
Phenol	6.0E-01 i	6.0E-01 i	6.0E-01 i	6.0E-01 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	3.9E+04	3.9E+04	3.9E+04	3.9E+04
m-Phenylenediamine	6.0E-03 i	6.0E-03 i	6.0E-03 i	6.0E-03 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	3.9E+02	3.9E+02	3.9E+02	3.9E+02
p-Phenylenediamine	1.9E-01 h	1.9E-01 h	1.9E-01 h	1.9E-01 h	0.10	1.3E+09	N	1.0E+06	1.0E+06	1.2E+04	1.2E+04	1.2E+04	1.2E+04
Phenylmercuric acetate	8.0E-05 i	8.0E-05 i	8.0E-05 i	8.0E-05 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	5.2E+00	5.2E+00	5.2E+00	5.2E+00
2-Phenylphenol	1.9E-03 h	1.9E-03 h	1.9E-03 h	1.9E-03 h	0.10	1.3E+09	N	1.0E+06	1.0E+06	9.8E+03	9.8E+03	9.8E+03	9.8E+03
Phorate	2.0E-04 h	2.0E-04 h	2.0E-04 h	2.0E-04 h	0.10	1.3E+09	N	1.0E+06	1.0E+06	1.3E+01	1.3E+01	1.3E+01	1.3E+01
Phosmet	2.0E-02 i	2.0E-02 i	2.0E-02 i	2.0E-02 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	1.3E+03	1.3E+03	1.3E+03	1.3E+03
Phosphine	3.0E-04 h	3.0E-04 h	3.0E-04 h	3.0E-04 h	0.10	1.3E+09	N	1.0E+06	1.0E+06	2.0E+01	2.0E+01	2.0E+01	2.0E+01
Phthalic anhydride	2.0E+00 i	2.0E+00 i	2.0E+00 i	2.0E+00 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	1.3E+03	1.3E+03	1.3E+03	1.3E+03
Picloram	7.0E-02 i	7.0E-02 i	7.0E-02 i	7.0E-02 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	4.6E+03	4.6E+03	4.6E+03	4.6E+03
Pinimphos-methyl	1.0E-02 i	1.0E-02 i	1.0E-02 i	1.0E-02 i	0.10	1.3E+09	N	1.0E+06	1.0E+06	6.5E+02	6.5E+02	6.5E+02	6.5E+02
Polybrominated biphenyls (PBBs)	8.9E+00 h	8.9E+00 h	8.9E+00 h	8.9E+00 h	0.10	1.3E+09	N	1.0E+06	1.0E+06	2.1E+00	2.1E+00	2.1E+00	2.1E+00
Polychlorinated biphenyls (PCBs)	2.0E+00 i	2.0E+00 i	2.0E+00 i	2.0E+00 i	0.06	1.3E+09	N	1.0E+06	1.0E+06	1.3E+01	1.3E+01	1.3E+01	1.3E+01
Polynuclear aromatic hydrocarbons													

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Chemical Name	SF ₀ 1/(mg/kg-d)	RfD ₀ (mg/kg-d)	SFI 1/(mg/kg-d)	RfDI (mg/kg-d)	ABS (unit/liter)	VF/PEF (m ² /kg)	Volatile	SAT (mg/kg)	1% FP (mg/kg)	CARCINOGENICITY		SYSTEMIC TOXICITY	
										Residential (mg/kg)	Non-Residential (mg/kg)	Residential (mg/kg)	Non-Residential (mg/kg)
Acenaphthene		6.0E-02 i		6.0E-02 i	0.10	1.3E+09	N	1.0E+06				3.9E+03	4.1E+04
Anthracene		3.0E-01 i		3.0E-01 i	0.10	1.3E+09	N	1.0E+06				2.0E+04	2.0E+05
Benz[a]anthracene	7.3E-01 n		7.3E-01 i		0.10	1.3E+09	N	1.0E+06		6.1E+00	2.6E+01	0.0E+00	0.0E+00
Benzo[b]fluoranthene	7.3E-01 n		7.3E-01 i		0.10	1.3E+09	N	1.0E+06		6.1E+00	2.6E+01	0.0E+00	0.0E+00
Benzo[k]fluoranthene	7.3E-02 n		7.3E-02 i		0.10	1.3E+09	N	1.0E+06		6.1E+01	2.6E+02	0.0E+00	0.0E+00
Benz[a]pyrene	7.3E+00 i		7.3E+00 i		0.10	1.3E+09	N	1.0E+06		6.1E-01	2.6E+00	0.0E+00	0.0E+00
Chrysene	7.3E-03 n		7.3E-03 i		0.10	1.3E+09	N	1.0E+06		6.1E+02	2.6E+03	0.0E+00	0.0E+00
Dibenz[a,h]anthracene	7.3E+00 n		7.3E+00 i		0.10	1.3E+09	N	1.0E+06		6.1E-01	2.6E+00	0.0E+00	0.0E+00
Fluoranthene		4.0E-02 i		4.0E-02 i	0.10	1.3E+09	N	1.0E+06				2.6E+03	2.7E+04
Fluorene		4.0E-02 i		4.0E-02 i	0.10	1.3E+09	N	1.0E+06				2.6E+03	2.7E+04
Indeno[1,2,3-cd]pyrene	7.3E-01 n		7.3E-01 i		0.10	1.3E+09	N	1.0E+06		6.1E+00	2.6E+01	0.0E+00	0.0E+00
Naphthalene		4.0E-02 n		4.0E-02 i	0.10	1.3E+09	N	1.0E+06				2.6E+03	2.7E+04
Pyrene		3.0E-02 i		3.0E-02 i	0.10	1.3E+09	N	1.0E+06				2.0E+03	2.0E+04
Prochloraz	1.3E-01 i		1.3E-01 i		0.10	1.3E+09	N	1.0E+06		3.0E+01	1.3E+02	5.9E+02	6.1E+03
Prochloraz	6.0E-03 h		6.0E-03 i		0.10	1.3E+09	N	1.0E+06				3.9E+02	4.1E+03
Prometon	1.5E-02 i		1.5E-02 i		0.10	1.3E+09	N	1.0E+06				9.8E+02	1.0E+04
Prometyn	4.0E-03 i		4.0E-03 i		0.10	1.3E+09	N	1.0E+06				2.6E+02	2.7E+03
Pronamide	7.5E-02 i		7.5E-02 i		0.10	1.3E+09	N	1.0E+06				4.9E+03	5.1E+04
Propachlor	1.3E-02 i		1.3E-02 i		0.10	1.3E+09	N	1.0E+06				8.5E+02	8.9E+03
Propazin	5.0E-03 i		5.0E-03 i		0.10	1.3E+09	N	1.0E+06				3.3E+02	3.4E+03
Propargite	2.0E-02 i		2.0E-02 i		0.10	1.3E+09	N	1.0E+06				1.3E+03	1.4E+04
Propargyl alcohol	2.0E-03 i		2.0E-03 i		0.10	1.3E+09	N	1.0E+06				1.3E+03	1.4E+04
Propazine	2.0E-02 i		2.0E-02 i		0.10	1.3E+09	N	1.0E+06				1.3E+03	1.4E+04
Propapham	2.0E-02 i		2.0E-02 i		0.10	1.3E+09	N	1.0E+06				1.3E+03	1.4E+04
Propiconazole	1.3E-02 i		1.3E-02 i		0.10	1.3E+09	N	1.0E+06				8.5E+02	8.9E+03
Propylene glycol	2.0E+01 h		2.0E+01 h		0.10	1.3E+09	N	1.0E+06				1.3E+06	1.4E+07
Propylene glycol, monoethyl ether	7.0E-01 h		7.0E-01 h		0.10	1.3E+09	N	1.0E+06				4.6E+04	4.8E+05
Propylene glycol, monomethyl ether	7.0E-01 h		7.0E-01 h		0.10	1.3E+09	N	1.0E+06				4.6E+04	4.8E+05
Propylene oxide	2.4E-01 i		1.3E-02 i		0.10	1.3E+09	N	1.0E+06		1.9E+01	7.9E+01	5.6E+02	5.9E+03
Pursult	2.5E-01 i		2.5E-01 i		0.10	1.3E+09	N	1.0E+06				1.6E+04	1.7E+05
Pyridin	2.5E-02 i		2.5E-02 i		0.10	1.3E+09	N	1.0E+06				1.6E+03	1.7E+04
Pyridine	1.0E-03 i		1.0E-03 i		0.10	1.3E+09	N	1.0E+06				6.5E+01	6.8E+02
Quinalphos	5.0E-04 i		5.0E-04 i		0.10	1.3E+09	N	1.0E+06				3.3E+01	3.4E+02
Quinoline	1.2E+01 h		1.2E+01 i		0.10	1.3E+09	N	1.0E+06		3.7E-01	1.6E+00	0.0E+00	0.0E+00
RDX (Cyclotol)	1.1E-01 i		1.1E-01 i		0.10	1.3E+09	N	1.0E+06		4.0E+01	1.7E+02	2.0E+02	2.0E+03
Resmethrin	3.0E-02 i		3.0E-02 i		0.10	1.3E+09	N	1.0E+06				2.0E+03	2.0E+04
Ronnel	5.0E-02 h		5.0E-02 h		0.10	1.3E+09	N	1.0E+06				3.3E+03	3.4E+04
Rotenone	4.0E-03 i		4.0E-03 i		0.10	1.3E+09	N	1.0E+06				2.6E+02	2.7E+03
Savay	2.5E-02 i		2.5E-02 i		0.10	1.3E+09	N	1.0E+06				1.6E+03	1.7E+04
Selenious Acid	5.0E-03 i		5.0E-03 i		0.10	1.3E+09	N	1.0E+06				3.3E+02	3.4E+03

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Chemical Name	STo 1/(mg/kg-d)	RfDo (mg/kg-d)	SFI 1/(mg/kg-d)	RfDI (mg/kg-d)	ABS (unitless)	VFPEF (m ² /kg)	Volatle	SAT (mg/kg)	CARCINOGENICITY		SYSTEMIC TOXICITY	
									Residential (mg/kg)	Non-Residential (mg/kg)	Residential (mg/kg)	Non-Residential (mg/kg)
Selenium		5.0E-03 i		5.0E-03 i	0.01	1.3E+09	N	1.0E+06			3.8E+02	8.5E+03
Selenourea		5.0E-03 h		5.0E-03 i	0.10	1.3E+09	N	1.0E+06			3.3E+02	3.4E+03
Seloxymium		9.0E-02 i		9.0E-02 i	0.10	1.3E+09	N	1.0E+06			5.9E+03	6.1E+04
Silver and compounds		5.0E-03 i		5.0E-03 i	0.01	1.3E+09	N	1.0E+06			3.8E+02	8.5E+03
Simazine	1.2E-01 h	5.0E-03 i	1.2E-01 i	2.0E-03 i	0.10	1.3E+09	N	1.0E+06	3.7E+01	1.6E+02	3.3E+02	3.4E+03
Sodium azide		4.0E-03 i		4.0E-03 i	0.10	1.3E+09	N	1.0E+06			2.6E+02	2.7E+03
Sodium dichloridithiocarbamate		3.0E-02 i	2.7E-01 i	3.0E-02 i	0.10	1.3E+09	N	1.0E+06	1.6E+01	7.1E+01	2.0E+03	2.0E+04
Sodium fluoracetate		2.0E-05 i		2.0E-05 i	0.10	1.3E+09	N	1.0E+06			1.3E+00	1.4E+01
Sodium metavanadate		1.0E-03 h		1.0E-03 i	0.10	1.3E+09	N	1.0E+06			6.5E+01	6.8E+02
Strontium, stable		6.0E-01 i		6.0E-01 i	0.01	1.3E+09	N	1.0E+06			4.6E+04	1.0E+06
Strychnine		3.0E-04 i		3.0E-04 i	0.10	1.3E+09	N	1.0E+06			2.0E+01	2.0E+02
Styrene		2.0E-01 i		2.9E-01 i	0.10	1.0E+04	Y	6.8E+02			3.4E+03	1.4E+04
Systhane		2.5E-02 i		2.5E-02 i	0.10	1.3E+09	N	1.0E+06			1.6E+03	1.7E+04
2,3,7,8-TCDD (dioxin)	1.5E+05 h		1.5E+05 h		0.03	1.3E+09	N	1.0E+06	3.8E-05	2.4E-04	0.0E+00	0.0E+00
Tebuflufen		7.0E-02 i		7.0E-02 i	0.10	1.3E+09	N	1.0E+06			4.6E+03	4.8E+04
Temephos		2.0E-02 h		2.0E-02 i	0.10	1.3E+09	N	1.0E+06			1.3E+03	1.4E+04
Terbacil		1.3E-02 i		1.3E-02 i	0.10	1.3E+09	N	1.0E+06			8.3E+02	8.9E+03
Terbufos		2.5E-05 h		2.5E-05 i	0.10	1.3E+09	N	1.0E+06			1.6E+00	1.7E+01
Terbutyn		1.0E-03 i		1.0E-03 i	0.10	1.3E+09	N	1.0E+06			6.5E+01	6.8E+02
1,2,4,5-Tetrachlorobenzene		3.0E-04 i		3.0E-04 i	0.10	1.3E+09	N	1.0E+06			2.0E+01	2.0E+02
1,1,1,2-Tetrachloroethane	2.4E-02 i	3.0E-02 i	2.6E-02 i	3.0E-02 i	0.10	1.1E+04	Y	1.2E+03	2.3E-01	5.4E+01	4.0E+02	1.5E+03
1,1,2,2-Tetrachloroethane	2.0E-01 i		2.0E-01 i		0.10	1.7E+04	Y	4.1E+03	4.4E+00	1.1E+01	0.0E+00	0.0E+00
Tetrachloroethylene (PCE)	5.2E-02 n	1.0E-02 i	2.0E-03 n	1.0E-02 i	0.10	4.3E+03	Y	6.4E+02	5.3E-01	1.7E+02	6.2E+01	2.1E+02
2,3,4,6-Tetrachlorophenol		3.0E-02 i		3.0E-02 i	0.10	1.3E+09	N	1.0E+06			2.0E+03	2.0E+04
2,3,4,5-Tetrachlorotoluene	2.0E-01 h		2.0E+01 i		0.10	1.3E+09	N	1.0E+06	2.2E-01	9.5E-01	0.0E+00	0.0E+00
Tetrachloroethoxyphos		3.0E-02 i	2.4E-02 i	3.0E-02 i	0.10	1.3E+09	N	1.0E+06	1.9E-02	7.9E+02	2.0E+03	2.0E+04
Tetraethyldithiopyrophosphate		5.0E-04 i		5.0E-04 i	0.10	1.3E+09	N	1.0E+06			3.3E+01	3.4E+02
Thallium oxide		7.0E-05 h		7.0E-05 i	0.01	1.3E+09	N	1.0E+06			5.4E+00	1.2E+02
Thallium acetate		9.0E-05 i		9.0E-05 i	0.01	1.3E+09	N	1.0E+06			6.9E+00	1.5E+02
Thallium carbonate		8.0E-05 i		8.0E-05 i	0.01	1.3E+09	N	1.0E+06			6.9E+00	1.5E+02
Thallium chloride		8.0E-05 i		8.0E-05 i	0.01	1.3E+09	N	1.0E+06			6.1E+00	1.4E+02
Thallium nitrate		9.0E-05 i		9.0E-05 i	0.01	1.3E+09	N	1.0E+06			6.1E+00	1.4E+02
Thallium selenite		9.0E-05 x		9.0E-05 i	0.01	1.3E+09	N	1.0E+06			6.9E+00	1.5E+02
Thallium sulfate		8.0E-05 i		8.0E-05 i	0.01	1.3E+09	N	1.0E+06			6.1E+00	1.4E+02
Thiobenzarb		1.0E-02 i		1.0E-02 i	0.10	1.3E+09	N	1.0E+06			6.5E+02	6.8E+03
2-(Thiocyanomethylthio)-benzothiazole (TCMTB)		3.0E-02 x		3.0E-02 i	0.10	1.3E+09	N	1.0E+06			2.0E+03	2.0E+04
Thiofanox		3.0E-04 h		3.0E-04 i	0.10	1.3E+09	N	1.0E+06			2.0E+01	2.0E+02
Thiophanate-methyl		8.0E-02 i		8.0E-02 i	0.10	1.3E+09	N	1.0E+06			5.2E+03	5.5E+04
Thiram		5.0E-03 i		5.0E-03 i	0.10	1.3E+09	N	1.0E+06			3.3E+02	3.4E+03
Tin and compounds		6.0E-01 h		6.0E-01 i	0.01	1.3E+09	N	1.0E+06			4.6E+04	1.0E+06

WORKSHEET FOR DEVELOPING SRLs

Chemical Name	Sf _o 1/(mg/kg-d)	RfD _o (mg/kg-d)	Sf _i 1/(mg/kg-d)	RfD _i (mg/kg-d)	ABS (unit/lb-ss)	VF/PEF (m ³ /kg)	Volatile	SAT (mg/kg)	1% FP (mg/kg)	CARCINOGENICITY		SYSTEMIC TOXICITY	
										Residential	Non-Residential	Residential	Non-Residential
										(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Toluene	3.2E+00 h	2.0E-01 i	3.2E+00 i	1.1E-01 h	0.10	4.9E+03	Y	8.8E+02	3.4E+03	1.4E+00	6.0E+00	7.9E+02	2.7E+03
Toluene-2,4-diamine					0.10	1.3E+09	N	1.0E+06				0.0E+00	0.0E+00
Toluene-2,5-diamine					0.10	1.3E+09	N	1.0E+06				3.9E+04	4.1E+05
Toluene-2,6-diamine					0.10	1.3E+09	N	1.0E+06				1.3E+04	1.4E+05
p-Toluidine	1.9E-01 i	2.0E-01 h	1.9E-01 i	2.0E-01 i	0.10	1.3E+09	N	1.0E+06		2.3E+01	1.0E+02	0.0E+00	0.0E+00
Towaphene	1.1E+00 i		1.1E+00 i		0.10	1.3E+09	N	1.0E+06		4.0E+00	1.7E+01	0.0E+00	0.0E+00
Tolamethan					0.10	1.3E+09	N	1.0E+06				4.9E+02	5.1E+03
Triallate					0.10	1.3E+09	N	1.0E+06				8.9E+02	8.9E+03
Triisulfon					0.10	1.3E+09	N	1.0E+06				6.5E+02	6.8E+03
1,2,4-Trinitrobenzene					0.10	1.3E+09	N	1.0E+06				3.3E+02	3.4E+03
Tributyltin oxide (TBO)					0.10	1.3E+09	N	1.0E+06				2.0E+00	2.0E+01
2,4,6-Trichloroaniline	3.4E-02 h	3.0E-05 i	3.4E-02 i	3.0E-05 i	0.10	1.3E+09	N	1.0E+06		1.3E+02	5.6E+02	0.0E+00	0.0E+00
2,4,6-Trichloroaniline hydrochloride	2.9E-02 h		2.9E-02 i		0.10	1.3E+09	N	1.0E+06		1.5E+02	6.6E+02	0.0E+00	0.0E+00
1,2,4-Trichlorobenzene					0.10	5.3E+04	Y	1.7E+03	5.9E+03			5.7E+02	4.7E+03
1,1,1-Trichloroethane					0.10	5.9E+03	Y	9.8E+02	4.8E+03			1.2E+03	6.3E+03
1,1,2-Trichloroethane					0.10	5.9E+03	Y	2.0E+03		6.3E+00	1.5E+01	3.3E+01	1.2E+02
Trichloroethylene (TCE)					0.10	3.1E+03	Y	9.2E+02		3.1E+01	7.0E+01	2.7E+01	9.2E+01
Trichlorofluoromethane					0.10	1.3E+03	Y	2.0E+03				3.8E+02	1.3E+03
2,4,5-Trichlorophenol					0.10	1.3E+09	N	1.0E+06				6.5E+03	6.8E+04
2,4,6-Trichlorophenol					0.10	1.3E+09	N	1.0E+06		4.0E+02	1.7E+03	0.0E+00	0.0E+00
2,4,5-Trichlorophenoxyacetic Acid					0.10	1.3E+09	N	1.0E+06				6.5E+02	6.8E+03
2,4,5-Trichlorophenoxypropionic acid					0.10	1.3E+09	N	1.0E+06				5.2E+02	5.5E+03
1,1,2-Trichloropropane					0.10	2.0E+03	Y	1.7E+03				1.5E+01	5.0E+01
1,2,3-Trichloropropane					0.10	1.3E+03	Y	1.7E+03		1.4E-02	3.1E-02	1.2E+01	3.8E+01
1,2,3-Trichloropropene					0.10	1.3E+03	Y	1.7E+03				1.1E+01	3.8E+01
1,1,2-Trichloro-1,2,2-trifluoroethane					0.10	1.6E+03	Y	5.0E+03	1.0E+04			2.1E+04	6.9E+04
Tridiphenyl					0.10	1.3E+09	N	1.0E+06				2.0E+02	2.0E+03
Triethylamine					0.10	8.8E+03	Y	1.1E+05				2.3E+01	8.4E+01
Trifluralin					0.10	1.3E+09	N	1.0E+06		5.8E+02	2.5E+03	4.9E+02	5.1E+03
Trimethyl phosphate					0.10	1.3E+09	N	1.0E+06		1.2E+02	5.2E+02	0.0E+00	0.0E+00
1,3,5-Trinitrobenzene					0.10	1.3E+09	N	1.0E+06				3.3E+00	3.4E+01
Trinitrophenylmethyldinitramine					0.10	1.3E+09	N	1.0E+06				6.5E+02	6.8E+03
2,4,6-Trinitrotoluene					0.10	1.3E+09	N	1.0E+06		1.3E+02	6.4E+02	3.3E+01	3.4E+02
Vanadium					0.01	1.3E+09	N	1.0E+06				5.4E+02	1.2E+04
Vanadium pentoxide					0.01	1.3E+09	N	1.0E+06				6.9E+02	1.5E+04
Vanadium sulfate					0.01	1.3E+09	N	1.0E+06				1.5E+03	3.4E+04
Vernam					0.10	1.3E+09	N	1.0E+06				6.5E+01	6.8E+02
Vinclozolin					0.10	1.3E+09	N	1.0E+06				1.6E+03	1.7E+04
Vinyl acetate					0.10	8.8E+03	Y	9.2E+03				7.8E+02	2.6E+03

WORKSHEET FOR DEVELOPING SRLs

Chemical Name	SFO 1/(mg/kg-d)	RfDo (mg/kg-d)	SFI 1/(mg/kg-d)	RfDI (mg/kg-d)	ABS (unitless)	VF/PEF (m ³ /kg)	Volatile	SAT (mg/kg)	CARCINOGENICITY		SYSTEMIC TOXICITY	
									Residential (mg/kg)	Non-Residential (mg/kg)	Residential (mg/kg)	Non-Residential (mg/kg)
Vinyl bromide	1.1E-01 r	8.6E-04 r	1.1E-01 h	8.6E-04 i	0.10	3.3E+03	Y	1.6E+04	1.9E+00	4.1E+00	4.1E+00	1.4E+01
Vinyl chloride	1.9E+00 h		3.0E-01 h		0.10	7.5E+02	Y	6.4E+03	1.6E-02	3.5E-02	0.0E+00	0.0E+00
Warfarin		3.0E-04 i		3.0E-04 r	0.10	1.3E+09	N	1.0E+06			2.0E+01	2.0E+02
White phosphorus		2.0E-05 i		2.0E-05 r	0.01	1.3E+09	N	1.0E+06			1.5E+00	3.4E+01
Xylene (mixed)		2.0E+00 i		2.0E-01 x	0.10	1.8E+04	Y	3.2E+02			5.3E+03	1.8E+04
Zinc		3.0E-01 i		3.0E-01 r	0.01	1.3E+09	N	1.0E+06			2.3E+04	5.1E+05
Zinc phosphide		3.0E-04 i		3.0E-04 r	0.01	1.3E+09	N	1.0E+06			2.3E+01	5.1E+02
Zincb		5.0E-02 i		5.0E-02 r	0.10	1.3E+09	N	1.0E+06			3.3E+03	3.4E+04

LEGEND:

COLUMN HEADINGS

SFO = Oral Slope Factor
RfDo = Oral Reference Dose
SFI = Inhalation Slope Factor
RfDI = Inhalation Reference Dose
ABS = Dermal Absorption Factor
VF = Volatilization Factor
PEF = Particulate Emission Factor
N = Nonvolatile chemical
Y = Volatile chemical
SAT = Soil Saturation Limit for VOCs
1%FP = Contaminant concentration for 1% of Pore Volume containing Free-phase

OTHER REFERENCES

i = IRIS
h = HEAST
n = NCEA
x = Withdrawn
r = Route Extrapolation
j = (Miller, 1993)

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7. A showing of good cause why the rule is necessary to promote a statewide interest if the rule will diminish a previous grant of authority of a political subdivision of this state:

Not applicable.

8. The summary of the economic, small business and consumer impact:

A.R.S. § 41-1055(A)(1): Identification of the Rulemaking.

This rule provides alternative approaches for determining soil remediation standards for those parties already required to clean up soil contamination under existing Departmental regulatory programs. In effect, the rule answers the question "How clean is clean?" The soil remediation standards established in this rule define "clean" at levels protective of human health and the environment.

The following 7 programs deal with soil remediations and are impacted by the rule. Below is a brief description of the programs' responsibilities.

- The Underground Storage Tank (UST) Program registers and inspects USTs to identify and prevent the leakage of hazardous substances. In the event a leaking UST (LUST) is discovered, the program has responsibility for ensuring clean up of contaminated soil, surface water and groundwater.
- The Hazardous Waste Management (HWM) Program regulates the generation, transportation, storage, treatment and disposal of hazardous wastes. Hazardous waste includes substances which exhibit a characteristic of ignitability, corrosivity, reactivity, or toxicity, in addition to certain listed wastes. The HWM Program ensures that any hazardous waste which is illegally disposed or discharged to the soil and groundwater is remediated.
- The Solid Waste and Special Waste Management (SWSWM) Programs regulate the proper handling, storage, treatment and disposal of household, industrial and special wastes not governed as hazardous wastes.
- The Water Quality Assurance Revolving Fund (WQARF) Program identifies, assesses and remediates soil and groundwater that are contaminated with hazardous substances. The WQARF Program conducts cleanups using state cleanup funds and through recovery of remediation costs from parties responsible for contamination. In addition, the Program provides approval and oversight of privately funded clean up activities.

A component of the WQARF Program is the Emergency Response (ER) Program. The ER program provides immediate on-scene response to chemical emergencies and conducts preliminary environmental hazard assessments. In addition, the ER program oversees remediation activities or mitigates the hazards in order to minimize threats to human health and the environment from the release of hazardous substances.

Another component of the WQARF program is the WQARF Voluntary Program. The WV Program provides an option for eligible persons remediating under the WQARF program to obtain an expedited review of investigative and remedial activities from the Department. Volunteers must enter into a reimbursement agreement to cover ADEQ's cost for review and oversight of the activities performed. Volunteers include persons who are legally responsible for the remediation under the WQARF Program as well as persons who are not legally responsible, but who wish to obtain the Department's concurrence that the property meets the Soil Remediation Standards.

- The Aquifer Protection Permit (APP) Program regulates discharges from wastewater treatment facilities, industrial sources, and mining operations. A hazardous substance discharged to soil or water which poses a threat to groundwater must be remediated or a permit must be obtained to ensure that groundwater quality is not adversely affected.
- The Greenfields Pilot Program (GP) is an expedited cleanup program intended to encourage voluntary remediation of up to 100 contaminated soil brownfields sites. Under the GP, a Remediation Specialist, certified by the Arizona Board of Technical Registration, performs the remediation, ensures the applicable criteria are met, and certifies that no further remediation work is necessary.
- The Voluntary Remediation Program provides an option for eligible persons to obtain an expedited review of investigative and remedial activities from the Department. Volunteers must enter into a reimbursement agreement to cover ADEQ's cost for review and oversight of the activities performed. Volunteers include persons who are legally responsible for the remediation under a regulatory program as well as persons who are not legally responsible, but who wish to obtain the Department's concurrence that the property meets the Soil Remediation Standards.

Prior to development of the Interim Soil Remediation Standards Rule, remediation levels were developed in a patchwork fashion, often resulting in overlap, inconsistencies, and delays in remediation. Each remediation of soil required an investment of time and money by both the regulated community and ADEQ to negotiate an acceptable cleanup level. In addition, each Departmental program had different cleanup levels. Some programs required remediation to the background concentration of contaminants, while others required remediation to a level that is not detectable by analytical methods. The varying standards led to confusion, or "shopping" for the "best" program, again resulting in delays in implementing remedial actions. This approach did not benefit the regulated community, nor the Department.

In September 1994, the Department invited representatives from industry, environmental organizations, and others to help develop risk-based remediation standards applicable to remediations conducted through the Department. This group was designated the Cleanup Standards/Policy Task Force. The Task Force focused its attention on developing risk-based standards for soil cleanups. A subcommittee of the Task Force was given the task to draft statutory language which would enable ADEQ to

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develop the risk-based standards. As a result, A.R.S. § 49-151 et seq. was passed into law in June 1995.

Due to the complexity of developing the risk-based standards and the desire of the legislature to establish uniform remediation levels quickly, the Department was directed to promulgate soil remediation standards in 2 steps. First, ADEQ was required to promulgate an emergency rule to adopt the Health-Based Guidance Levels (HBGLs) developed by the Arizona Department of Health Services as residential cleanup standards. The HBGLs, initially developed to be used as a screening tool at ADEQ, were based solely on the ingestion of contaminated soil under a residential exposure scenario. In addition, the Department was mandated to develop a total petroleum hydrocarbon standard (TPH) and non-residential HBGLs. The 2nd step directed the Department to promulgate permanent risk-based standards through normal rulemaking.

The emergency soil standards, termed the Interim Soil Remediation Standards Rule (Interim Rule), became effective in March 1996. In addition to the pre-determined HBGLs, remediating parties were given the option to develop site-specific remediation levels derived from a human health risk assessment. The Interim Rule also provided a process for remediating parties to obtain a letter from the Department acknowledging whether the soil standards have been met. In addition, the rule provided a means to obtain information for the Repository (a database of remediated sites).

The Final Soil Remediation Standards Rule (Final Rule), represents the 2nd step in establishing uniform soil remediation levels, and provides parties conducting soil remediations with different approaches for determining appropriate risk-based soil remediation levels. The 1st approach allows the use of pre-determined remediation standards. These "off-the-shelf" standards, called Soil Remediation Levels (SRLs), were calculated by ADHS using models and assumptions which were developed by the United States Environmental Protection Agency (EPA). The SRLs use EPA toxicity values and conservative assumptions in order to be protective over a wide range of site characteristics. In addition, the SRLs include the inhalation and dermal exposure routes which were not considered in the HBGLs, but which were recommended by Task Force members as well as experts in the health care field and related areas.

Under a 2nd approach, a party may develop remediation levels based on a site-specific risk assessment. This allows an opportunity to develop remediation levels based on the particular characteristics of a site. The Final Rule even specifies a range of risks to determine an appropriate remediation level. The resulting remediation levels may result in greater concentrations of contaminants left in the soil than the SRLs, but still are protective of human health. A 3rd approach allows for a site to be remediated to the level of the contaminant naturally occurring in the soil.

Both the pre-determined and site-specific standards provide parties with the choice to remediate to either residential or non-residential standards. The Final Rule provides flexibility for the remediating party in selecting a remediation standard that is protective of human health while allowing the standard to be appropriate for the use of the property. For instance, industrial properties are no longer required to remediate to levels that would be protective of children living on the site if there is no potential for residential use. The party conducting the remediation can decide to remediate to more protective standards at their discretion, not the Department's.

Remediation to residential standards is considered to be the most protective of human health. Therefore, remediation to this level does not require notification or limitations on the use of the property. If remediation to non-residential levels is selected, a Voluntary Environmental Mitigation Use Restriction (VEMUR) must be filed with the county recorder. The VEMUR provides notice that the property has not been cleaned up to a level that is protective of residential use and that the property owner agrees to limit the property to non-residential use. The statute provides for approval and signature of a Department official on the VEMUR form. The Department signature verifies that the non-residential standards have been achieved at the property. The choice of remediation standards should facilitate property transfers by providing predictable and protective standards based on the probable future use of the property. When property transactions occur, the notification requirements provide buyers and lenders with necessary and relevant information.

Regardless of the choice to remediate to the pre-determined or site-specific standards, no concentration of contaminants remaining in the soil after remediation may: 1) Violate Water Quality Standards; 2) Exhibit a hazardous waste characteristic of ignitability, corrosivity, or reactivity; or 3) Cause an adverse effect to ecological receptors. Remediating parties must demonstrate that the 1st 2 conditions have been met. However, the Department will evaluate sites to determine if a potential for adverse impacts to ecological receptors exists. If the Department determines that ecological receptors may be impacted, the remediating party must conduct an ecological risk assessment to determine the appropriate remediation necessary.

Due to the fact that the soil remediation standards have changed, remediating parties are given the choice to remediate under the Final Rule if the standards in the Final Rule are less stringent than the standards in the Interim Rule. However, if the new standards are more stringent, the remediating party must determine if the site being remediated has been characterized. If the site has been characterized before the effective date of the Final Rule, the remediating party may cleanup to the standards under the Interim Rule.

In addition to establishing remediation standards, the statute requires the Department to establish a repository of sites that are remediated under the Department's programs. This requirement was provided in response to the public's concern that information about all soil remediations be made available. Because remediation activities can take considerable lengths of time to complete, concerns were expressed that the database also must contain information about ongoing remediations in order to be of real value. Therefore, the rule requires parties to submit a Notice of Remediation prior to conducting a soil remediation to ensure that accurate and timely information is entered into this database early in the process. Additionally, many parties were adamant that the Department issue some form of verification that the soil remediation is complete. The Final Rule provides a process for a remediating party to obtain a Letter of Completion from the Department verifying that the soil remediation is complete. If a

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remediating party requests a Letter of Completion, they must submit a minimum amount of information to the Department. The individual Departmental programs will evaluate the information submitted to verify whether the soil remediation standards have been achieved and issue a Letter of Completion or request additional information to make the verification.

A.R.S. § 41-1055(A)(2): Summary of the Economic, Small Business and Consumer Impact Statement

The probable benefits of the Final Rule outweigh the probable costs for several reasons. When the rule, which sets forth a consistent set of risk-based Department-wide cleanup standards, is measured against the benchmark of the previous ad hoc site-by-site negotiations, several benefits and reduced costs emerge. The costs and benefits described in this summary are those which result primarily for the persons who remediate.

Benefits

1. Parties Have Regulatory Flexibility to Make Remediation Decisions Which They Believe Are In Their Economic Self-Interest.

The Final Rule sets forth options for remediating parties to choose remediation approaches and, generally speaking, remediation levels. Within limits, a party can choose to remediate to a pre-determined standard ("off the shelf" approach), to a level derived from a risk assessment ("customized" approach), or to the background concentration of a naturally occurring contaminant. In addition, a party can choose to remediate to a level that is appropriate for the use of the property (residential or non-residential).

The remediating party is the primary decision-maker regarding the remediation and has several options available from which to choose. Compliance costs should be less due to the fact that the decision maker is free to weigh the various options and choose the 1 which maximizes their economic self-interest. Decisions are contingent on current land use as well as most probable land use, and must be protective of human health and the environment, but the specific choice is in the hands of the party conducting the remediation, not the Department's. For example, if the site being remediated is an industrial site and it is highly unlikely that the land will be used for residential purposes, a person may choose to remediate to non-residential standards. The balance of the cost savings from choosing to remediate to the non-residential standard must be weighed against the potential impact of the requirement to file a VEMUR. However, if the land owner determines that the land value and its marketability will be enhanced by a cleanup to residential standards, cleanup to residential levels may ultimately be more cost-effective. Again, the Final Rule sets forth approaches and the remediating party is free to choose the approach.

2. Reduced Transactional Costs and Speedier Implementation of Remediation.

Consistent, Department-wide standards reduce the transactional costs for regulated parties as well as the Department. As noted previously, prior to consistent standards, regulated parties and the Department often engaged in lengthy site-by-site negotiations. This ad-hoc approach required significant outlays of time and money by the parties involved. Consistent Department-wide standards reduce the time and expense involved in negotiating cleanup levels. Reducing the transaction time means remediation can begin, and presumably be completed, in a shorter length of time. The result is that contaminated property is brought back to an economically productive use sooner. In addition, owners, buyers, and lending institutions are able to make decisions and accomplish property transfers in a more timely manner.

3. Greater Reliability and Predictability of Remediation Outcomes Result In Increased Productive Use of Property.

Consistent Department-wide standards provide greater reliability and predictability of remediation outcomes. As noted previously, prior to consistent standards, varying remediation levels created uncertainty among the remediating parties, lending institutions, and buyers. Without a predictable remediation level, it was unknown how much the remediation would cost and how long it would take to complete. Consistent Department-wide standards facilitate property transfers by providing predictable standards based on the probable future use of the property. This allows owners, buyers, and lending institutions to make appropriate decisions with some certainty. The result is increased voluntary remediation of contaminated property which will bring otherwise non-productive properties back into productive use and back on the tax rolls.

4. Risk-based Remediations Represent a More Effective Use of Public and Private Resources.

The Final Rule is based on the idea of "risk-based remediation," which means that cleanup levels relate to risk to human health and the environment posed by contaminated soil. Risk-based remediation should result in greater cost effectiveness for both the Department and the remediating party by better matching expenditures to the contaminated sites posing the greatest amount of risk. Risk-based remediation has the effect of creating a "bigger bang for the buck" since each dollar spent on risk-based remediation reduces a greater proportion of risk than monies spent on remediations which are not risk-based. In addition, prior to the Interim Rule, all property was required to be remediated to 1 standard, regardless of the use of the property. The creation of non-residential standards allows flexibility in matching remediation levels to the probable future use of the property.

5. Availability and Quality of Information Is Increased

The Final Rule is expected to bring more clarity and consistency to the remediation efforts, increasing the quality of information for current land users as well as prospective land purchasers. In addition, the Notice of Remediation, the VEMUR, and the Letter of Completion will all be made available in the Departmental Repository which will enable the general public, property buyers, and lending institutions to obtain information about remediated sites. This information can be used to determine if remediation levels achieved are consistent with the intended use of the land. This allows all parties to make sound decisions.

6. The Letter of Completion Increases Property Marketability.

Prior to the Interim Rule, Departmental programs did not have a consistent policy of issuing a "Close Out Document." Even when a "Close Out Document" was issued indicating that no further soil remediation was required, it had limited meaning as it simply attested to the fact that 1 program determined its soil remediation standards were met. The Letter offered no assurance that other Departmental soil remediation standards had been met. Under the Final Rule, the Letter of Completion represents a significant increased benefit since it carries assurance that Department-wide soil remediation standards have been met. As such, the Letter of Completion facilitates property transfers by providing pertinent information regarding the attainment of soil remediation standards.

Costs

1. Administrative and Reporting Costs May Slightly Increase.

The Notice of Remediation is required of all parties conducting soil remediation in order to provide information to the public regarding proposed and on-going soil remediations. The notice information will be entered into the Repository which will be made available to the public. The remediating party bears the cost of complying, which consists of providing the Department with a description of the soil remediation project, the rationale for selection of soil remediation levels, and the description of the remediation technologies. The Department will provide a short form to remediating parties to facilitate submittal of the information.

The VEMUR is only required of those parties who have chosen to remediate properties to non-residential levels. The costs consist of the recording fee required by the county recorder and the transactional cost of completing the form as prescribed in statute. Likewise, a person who filed a VEMUR, but later chooses to file a VEMUR Cancellation (attesting that the property has been remediated to residential standards), bears the recording fee and the transactional costs associated with completing the statutory form.

Another type of report is required only if a remediating party requests a Letter of Completion which is a Departmental statement verifying that the soil remediation standards have been achieved. Where the Letter of Completion is requested, a description of the actual remediation activities, technologies, and techniques is required, along with soil sampling results and documentation that rule requirements or conditions have been met.

Costs associated with complying with the administrative and reporting requirements stem from filling out required forms and, more significantly, generating the information to include on the forms. These reporting costs are expected to be negligible due to the fact that the most of the information must be collected to satisfy the requirements of the existing regulatory programs. Only the VEMUR is unique to the rule. The time needed to complete the forms should also be negligible due to the fact that the information should be readily available to the remediating party and forms for submittal of the information will be provided by the Department.

2. Actual Remediation Cost Will Vary.

Contaminated sites vary according to their physical characteristics, the variability of contaminants, and the extent of contamination. The cost of remediation is driven by these varying factors. In addition, the cost of remediation is determined by the cleanup standard chosen by the remediating party. In order to determine the impacts to the cost of remediation from this rule, it is necessary to compare the remediation levels prior to promulgation of the Interim Rule as well as the levels in place during the Interim Rule. Due to the site-specific nature of cleanup levels derived from a risk assessment or background concentrations, only the pre-determined standards can be compared. This comparison is also limited to the types of contaminants commonly addressed by the various Departmental programs which deal with soil remediation.

As stated previously, prior to the Interim Rule, each Departmental program had different soil remediation levels. The remediating party was required to clean up the soil to the contaminant concentration level determined by the program. There was no option to remediate to a non-residential level. In addition, risk assessments were only allowed in limited situations.

With the promulgation of the Interim Rule, the remediating parties had several options from which to choose and the cost of the remediation differs according to the options chosen. The remediating party could cleanup to the pre-determined standards (the HBGLs), a level derived from a risk assessment, or to a background concentration of a naturally occurring substance. In addition, the remediating party also has the choice (within certain limits) of remediating to a level protective of residential use, or 1 protective of non-residential use. The residential standard is more protective and is more costly to achieve. In any event, the remediation level selected must be protective of groundwater quality. For many contaminants, groundwater protection is a more stringent requirement than the HBGLs.

The Final Rule uses the same framework as the Interim Rule since it provides options as long as certain conditions are met. Remediating parties still can choose the remediation approach and the remediation level based on the use of the property. However, the pre-determined standards were recalculated to include the inhalation and dermal routes of exposure. In addition, the risk management level was changed from 1×10^{-6} for all carcinogens to 1×10^{-6} for known carcinogens (Class A) and 1×10^{-5} for other carcinogens (Classes B and C). A hazard quotient no greater than 1 was retained for systemic toxicants.

As a result of these modifications, the Final Rule pre-determined standards were renamed the Soil Remediation Levels (SRLs). In general, volatile contaminant SRLs are lower than the volatile contaminant HBGLs due to the inclusion of the inhalation exposure route. In addition, most of the residential SRLs are lower than the residential HBGLs for the same contaminants. Con-

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versely, most of the non-residential SRLs are higher than the non-residential HBGLs for the same contaminants. It should be noted that the chosen cleanup level still must be protective of groundwater quality.

The following is a brief summary of the programs which deal with soil remediation and the impacts associated with the changes to the pre-determined standards. Due to the site-specific nature of levels derived from a risk assessment or background concentrations, only the pre-determined standards can be compared.

Underground Storage Tank (UST) Program. Remediations conducted under the UST Program deal primarily with petroleum products, including benzene, toluene, ethylbenzene, and xylenes (the common constituents of gasoline otherwise known as BTEX) and total petroleum hydrocarbons (TPH). Prior to the Interim Rule, the UST Program required cleanup to the Suggested Soil Cleanup Levels (SSCLs). During the Interim Rule, contaminants could be remediated to the HBGLs. However, BTEX contaminants usually had to be remediated to a more protective level to prevent adverse impacts to groundwater. The Final Rule provides the option to remediate to the SRLs. However, the chosen remediation level must still be protective of groundwater. The following table compares the different cleanup levels for common contaminants remediated under the UST Program. For example, before the Interim Rule, concentrations of benzene in the soil had to be remediated to 0.13 mg/kg.

Contaminant	Pre-Interim Rule SSCLs (mg/kg)	Interim Rule HBGLs (mg/kg)		Final Rule SRLs (mg/kg)	
		Residential	Non-Residential	Residential	Non-Residential
Benzene	0.13	47.0	197.0	0.62	1.4
Toluene	200.0	23,000.0	80,500.0	790.0	2,700.0
Ethylbenzene	68.0	12,000.0	42,000.0	1,500.0	2,700.0
Xylenes	44.0	230,000.0	805,000.0	2,800.0	2,800.0
TPH	100.0	7,000.0	24,500.0	4,100.0*	18,000.0*

* The TPH standard changed to hydrocarbons C₁₀₋₃₂.

Hazardous Waste Management (HWM) Program. The most common contaminants remediated under the HWM Program include industrial solvents, heavy metals, and pesticide spills. Prior to the Interim Rule, the HWM Program required soil remediation to a non-detectable contaminant concentration level or to a background concentration. During the Interim Rule, hazardous wastes could be remediated to the HBGLs. However, volatiles and metals were often remediated to more protective levels to prevent adverse impacts to groundwater. The Final Rule provides the option to remediate to the SRLs. However, the chosen remediation level must still be protective of groundwater. The following table compares the different cleanup levels for common contaminants remediated under the HWM Program:

Contaminant	Pre-Interim Rule (mg/kg)	Interim Rule HBGLs (mg/kg)		Final Rule SRLs (mg/kg)	
		Residential	Non-Residential	Residential	Non-Residential
Cadmium	Non-Detect	58.0	244.0	38.0	850.0
Chromium (Total)	Non-Detect	1,700.0	5,950.0	2,100.0	4,500.0
Lead	Non-Detect	400.0	1,400.0	400.0	2,000.0
Toxaphene	Non-Detect*	1.2	5.0	4.0	17.0
Tetrachloroethylene	Non-Detect	27.0	113.0	53.0	170.0
Trichloroethylene	Non-Detect	120.0	504.0	27.0	70.0

* Or to a negotiated background level

Solid Waste and Special Waste Management (SWSWM) Programs. Substances remediated by the SWSWM Programs include mainly petroleum products. Please see the table for the UST Program for a comparison of the different cleanup levels for TPH.

Water Quality Assurance Revolving Fund (WQARF) Program. Substances frequently remediated under the WQARF Program include industrial solvents, heavy metals, and pesticide spills. Prior to the Interim Rule, the WQARF Program generally required cleanup to levels protective of groundwater quality. During the Interim Rule, hazardous substances could be remediated to the HBGLs. However, volatiles and metals were often remediated to more protective levels to prevent adverse impacts to

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groundwater. The Final Rule provides the option to remediate to the SRLs. However, the remediation level must still be protective of groundwater. Please see the table for the HWM Program for a comparison of the different levels for common contaminants remediated under the WQARF Program.

APP Program. The majority of substances remediated under the APP Program are heavy metals. Prior to the Interim Rule, the APP Program required cleanup to levels protective of groundwater quality. During the Interim Rule, hazardous substances could be remediated to the HBGLs. However, metals were often remediated to levels more protective due to impacts to groundwater. The Final Rule provides the option to remediate to the SRLs. However, the remediation level must still be protective of groundwater. Please see the table for the HWM Program for a comparison of the different cleanup levels for common metal contaminants remediated under the APP Program.

Greenfields Pilot Program. The Greenfields Pilot Program did not exist prior to the Interim Rule. Remediations had to be conducted according to the requirements of the previous 6 programs.

Voluntary Remediation Program. Due to the nature of the program as an expedited review program for all of the existing regulatory programs as well as for voluntary cleanups, remediations conducted under the Voluntary Remediation Program can include any regulated substance (please see tables for other programs). However, remediations conducted voluntarily (not required under A.R.S. Title 49) often deal with agricultural fields which are now being converted into residential housing. Pesticide applications are the major concern at these sites. Prior to the Interim Rule, the Voluntary Remediation program did not exist and any voluntary remediations had to be conducted according to the cleanup levels prescribed by the existing regulatory programs described previously. During the Interim Rule, any substance could be remediated to the HBGLs as long as the cleanup levels were protective of groundwater. The Final Rule also provides the option to remediate to the SRLs as long as the cleanup levels are protective of groundwater. The following table compares the different cleanup levels for common contaminants remediated under the Voluntary Remediation Program:

Contaminant	Pre-Interim Rule (mg/kg)	Interim Rule HBGLs (mg/kg)		Final Rule SRLs (mg/kg)	
		Residential	Non-Residential	Residential	Non-Residential
DDT	Determined By Program	4.0	17.0	13.0	56.0
Toxaphene	Determined By Program	1.2	5.0	4.0	17.0

A comparison of the pre-determined cleanup levels under the various Departmental programs indicates few changes to the cleanup levels for the contaminants most likely to impact groundwater (that is, volatiles and metals). Although the pre-determined cleanup levels may have changed through the promulgation of both the Interim and Final Rules, all programs have required and still require soil cleanup levels to be protective of groundwater.

Conversely, the biggest changes occurred for contaminants which typically do not impact groundwater and these changes occurred when the Interim Rule was promulgated. For example, the TPH cleanup level for several programs was 100 mg/kg prior to the promulgation of the Interim Rule. After the Interim Rule, the TPH cleanup level increased to 7,000 mg/kg for residential use and 24,500 mg/kg for non-residential use. The changes which will occur with the promulgation of the Final Rule are generally incremental changes and are not as dramatic.

3. Performing a risk assessment may result in a less costly remediation level, but includes the expense of hiring a risk assessment consultant.

If the remediating party believes that conditions at their site differ from the assumptions used to calculate the SRLs, it may be beneficial to conduct a site-specific risk assessment to determine a remediation level. This may result in cleanup levels greater than the SRLs. A party choosing this approach bears the additional cost of hiring a consultant to perform the risk assessment. This cost of performing a risk assessment is in addition to the cost of conducting the actual remediation. However, this cost may be offset by savings realized from the reduced cost of the actual remediation if the site conditions do in fact differ favorably from the SRL assumptions. Again, as discussed earlier, this is the choice of the remediating party, and the Department assumes that a remediating party will choose the remediation approach that maximizes their economic self-interest. It should be noted that the Department has developed guidance to allow a person to conduct a limited risk assessment by using default exposure assumptions in conjunction with site-specific conditions. This guidance will facilitate the use of risk assessments and reduce the associated costs.

4. Performing an ecological risk assessment will increase the cost of remediation.

In addition to protecting human health, every remediated site must be protective of the environment. Contaminant levels that are protective of human health may not be protective of ecological receptors. In order to minimize the potential economic impact of this requirement, the Department bears the burden of identifying those sites that may cause an adverse impact to ecological receptors. The Department will identify the existence of ecological receptors and whether or not contaminants are likely to reach those receptors. This screening process should eliminate many sites, including most urban sites. The Department will

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require further action for the remainder of the sites where impacts are probable. Further action may include assessment or remediation. Remediation does not necessarily entail treatment or removal of soil. Remediation may include elimination of the complete exposure pathway, for example, capping or installing a berm. The impact of this rule requirement may be costly to those few sites required to conduct an ecological risk assessment. However, there is no increased cost to the sites which are screened out of the process. It should be noted that the Department already has authority under the general Departmental duties or individual program authority to protect the environment, but only a handful of ecological risk assessments have ever been required.

A.R.S. § 41-1055(B)(2): Persons Directly Affected by the Rule

Responsible Parties

Responsible Parties are persons or entities required to conduct soil remediation under Arizona law. Responsible parties can be private citizens, businesses, state agencies or political subdivisions of the State. This includes anyone who owns contaminated property or was responsible for the contamination of the property.

Volunteers

Volunteers include any person who is not required by state law to remediate contaminated property, but who wishes to do so voluntarily. This includes developers or land owners who purchase contaminated land, such as old agricultural land where pesticides were legally applied. This type of land is often converted into residential property and the owners may wish to remediate the property to reduce future liability.

State Agencies

The Arizona Department of Environmental Quality is the agency responsible for the implementation of this rule. The Arizona Department of Health Services (ADHS) developed the SRLs for the rule. ADHS also provides consulting services on risk assessments under contract to the Department. Other state agencies will be affected if they are responsible parties as described above.

Political Subdivisions of the State

Political subdivisions will be affected if they are responsible parties as described above. In addition, remediated property will impact development plans and will add value to the tax base. Furthermore, whenever soil contamination is remediated to non-residential standards, the property owner is required to file a Voluntary Environmental Mitigation Use Restriction (VEMUR) with the County Recorder's Office of the relevant jurisdiction.

Private Companies

Private sector consulting companies and attorneys specializing in environmental remediation will be affected by this rule. Private companies that are responsible parties will also be affected by this rule as described above.

Landowners, Lenders, and Buyers

Landowners, lenders, and buyers will be indirectly impacted by the purchasing and selling of remediated property. These people will be directly affected if they are responsible parties as described above.

Consumers and Taxpayers

Consumers and taxpayers may be indirectly impacted by the rule. Any change in the cost of soil remediation resulting from changes to the remediation standards may be passed along to consumers of products produced by companies already identified as responsible parties. Ultimately, taxpayers pay for remediation of properties by the State or its political subdivisions. Therefore, taxpayers may be indirectly impacted by any increase or decrease in cost of remediation to meet the final standards. Additionally, any efficiencies realized from reduced transactional costs, speedier remediations, and remediations focused on sites posing true risk to human health and the environment will indirectly decrease costs borne by taxpayers.

The General Public

The establishment of consistent, risk-based soil remediation standards ensures protection of human health and the environment. The return of vacant properties to active use will improve community appearances and tax bases. In addition, the Repository will provide public accessibility to remediation information.

A.R.S. § 41-1055(B)(3): Cost-Benefit Analysis

Data Limitations

The ability to conduct a traditional cost-benefit analysis that quantifies and monetizes the impacts of this rule is rendered difficult, if not impossible, by the fact that there is no such thing as a "typical" remediation site from which to draw inferences about the entire universe of existing remediation sites in Arizona. Contaminated sites vary tremendously in their physical and geological characteristics, as do the types of contaminants, the extent and concentration of contamination, the presence or absence of groundwater contamination and a whole host of other variables that can heavily influence the cost of remediation. The availability of options under the rule also makes it difficult to predict the standard a party will choose for a particular site.

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In addition, ADEQ cannot reference historical data about remediation costs because these are not routinely collected by the relevant programs. The only program which has any cost-related data is the UST Program because they routinely reimburse remediation costs through the SAF.

ADEQ commissioned Peterson Consulting LLC (PCLLC) to develop a framework for estimating future corrective action costs for known leaking underground storage tank (LUST) sites eligible for reimbursement from the State Assurance Fund (SAF). SAF monies are derived from the 1¢ per gallon tax levied on gasoline and all other regulated substances under the UST program. PCLLC developed a cost estimation model which was submitted to ADEQ in October 1995. In March 1997, PCLLC updated the 1995 report and incorporated current site information, and relevant statute, rule and ADEQ policy changes. The relevant rule and policy changes identified for purposes of the cost estimation include the following: Fund Eligibility for Closed Sites; Low Priority Site Closure Special Project; Multiple Release Policy; Interim Soil Remediation Standards Rule; Corrective Action Cost Ceilings; Pre-Approval Rules; and Extent of Coverage Provisions.

The 1997 cost estimation study used 5 basic categories of sites as indicators of how the LUST sites, and therefore the remediation costs, could vary. When comparing 1995 versus 1997 costs, the study shows that estimated costs decrease in 4 out of the 5 LUST site categories. The % decreases in the estimated costs for the 2 years range from 7% for Category 1 - Complex Groundwater Site to 49% for Category 4 - Standard Soil Site. In only 1 category, Category 5 - Simple Soil Site, is there a projected increase of 8% (Peterson Consulting L.L.C. 1997).

Although the PCLLC study provides cost estimates on the impacts of the Interim Rule on UST remediations, these average figures cannot be used reliably to make projections for other programs. There are specific rules and formulas pertaining to how SAF monies are calculated and disbursed. In addition, UST costs are not representative of all soil remediation costs due to the limited range of chemicals and release conditions for USTs as well as the extreme variability of site characteristics and contaminants under other programs.

Rather than employ speculative data that cannot be used meaningfully, the Department argues that the most crucial cost determinant is the cleanup standard that is chosen by the remediating party. The residential standards are more stringent than non-residential standards, and all other things being equal, remediation to the more stringent standards will be more costly to achieve. In implementing this rule, ADEQ does not prescribe a particular cleanup standard for any site, but leaves the choice to the remediating party. The remediating party is given 1 of 5 choices to pursue (residential or non-residential, and pre-determined, risk assessment, or background), in effect allowing the regulated entities to control remediation decisions. Given the variability of site characteristics and the remediation choices available, it is impossible to predict the remediation costs.

Finally, it is not possible to quantify the impacts to human health or the environment. This rule should result in more sites being remediated, as defined by statute. The benefits are generally intangible, such as the reduction of risk, the improved quality of life, and improved appearances of communities.

Costs and Benefits to ADEQ, the Implementing Agency

The Departmental programs that will implement this rule are: the UST Program; the SWSWM Programs; the HWM Program; the WQARF Program; the APP Program; the Voluntary Remediation Program; the Greenfields Pilot Program; and any other program under A.R.S. Title 49 that regulates soil remediation. The staff in these programs already oversee current remediation efforts in the State. No new program staff will be hired and no new revenues are anticipated as a result of this rulemaking.

However, there are costs to the Department associated with the rule. It is anticipated that more risk assessments will be conducted which will require more ADHS consulting services. Departmental staff will also require training on both human health risk assessments and ecological risk assessments as well as training on this rule. The Department will also be required to maintain the Repository including entering information from the Notices of Remediation and Letters of Completion.

On the other hand, there are significant benefits associated with the rule. Because the pre-determined Soil Remediation Levels (SRLs) and risk assessments are based on the best scientific evidence available to date, implementation of this rule will enable the Department to accomplish its mission of protecting public health and the environment more efficiently. The risk-based standards enable the Department to focus its efforts and those of the regulated community on remediation of sites posing the greatest risk. Remediations should occur more quickly because of the reduced time required to negotiate cleanup standards prior to implementation. Consistent standards also assure that remediations performed under 1 departmental program will satisfy the remediation levels of other departmental programs. In addition, the predictability of remediation outcomes should encourage parties to undertake remediation.

Costs and Benefits to Other State Agencies

The Department has contracted with ADHS to conduct risk assessments for the Department and to review the risk assessments submitted to Departmental programs. No incremental costs and benefits to ADHS are anticipated. However, if more responsible parties choose the risk assessment option, the Department's demand for ADHS services will increase. The Department expects that demand for legal services from the Arizona Attorney General's Office will decrease as a result of the reduced need to negotiate cleanup standards. State agencies that are responsible parties will incur the costs and benefits described in the summary of this EIS.

Costs and Benefits to Political Subdivisions

Remediated property will improve community appearances and will add value to the tax base. County Recorder Offices throughout the State will record the VEMURs whenever the non-residential standards are selected. A nominal filing fee, deter-

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mined by the County under its authority, is charged to the land owner. No new revenues or staff are anticipated as a result of the rule. However, revenues may increase depending on the number of VEMURs filed. Municipalities and other political subdivisions of the State who are responsible parties will incur the costs and benefits described in the summary of this EIS.

Costs and Benefits to Private Businesses

Three types of businesses will be most impacted by this rule: 1) Private businesses that are responsible parties; 2) Private businesses that remediate property voluntarily; and 3) Private businesses, such as environmental consulting firms and attorneys, providing remediation services. Private businesses that are responsible parties or volunteers will incur the same costs and benefits described in the summary of this EIS.

The Department anticipates that more remediations, as defined by statute, will occur as a result of this rulemaking. The demand for consulting services may increase although the overall cost to remediate contaminated soil will change only as the standards have increased or decreased in stringency. The demand for consultants who provide risk assessment services is anticipated to increase. Conversely, it is anticipated that the demand for legal services formerly needed in negotiating cleanup standards will decrease. There may be a decrease in the demand for certain remedial technologies (for example, a decrease in the need for land-fill space, a decrease in transport, storage and disposal services). The new hydrocarbon standard (4,100 mg/kg) is much less stringent than prior to the Interim Rule (100 mg/kg). Therefore, the number of sites to be cleaned up and the need for related remedial services (for example, soil burning) will be reduced. The rule does not affect responsible party eligibility to receive reimbursement of remediation costs either from other responsible parties under WQARF or from the State Assurance Fund (SAF).

A.R.S. § 41-1055(B)(4): Impacts on Public and Private Employment

No incremental changes in public or private employment are foreseen as a result of this rule. If more sites move to remediation as a result of the rule, some consulting companies may hire more staff. The demand for people with risk assessment and/or toxicological expertise is expected to increase as a result of the rule option allowing the determination of site-specific standards from a risk assessment.

A.R.S. § 41-1055(B)(5): Impacts on Small Businesses

Small Businesses Subject to the Rule

Data from the latest economic census show that 98% of the business establishments in Arizona are small businesses to the extent that they have fewer than 100 employees. No data are available on whether these businesses have gross revenues of \$4 million or less. Likewise, no data or analyses are available regarding whether or not the regulated entities are "leaders" in their field or are independently owned and operated. Thus, the vast majority of business owners who are also responsible parties subject to this rule are presumed to be "small" by the criteria indicated in the statutory definition of small business.

Administrative Costs to Small Businesses

There are minimal administrative costs to any business subject to this rule, including small business. There will be administrative costs associated with preparing the Notice of Remediation, requesting a Letter of Completion and, if applicable, filing a VEMUR.

Reduction of Cost Impact on Small Businesses

A.R.S. 41-1055(B)(5)(c) requires the Department to describe the methods it may use to reduce the cost impact of a proposed rule on small businesses. A description of methods used to simplify, consolidate, or exempt compliance, reporting, scheduling, and deadline requirements of the proposed rule for small businesses is discussed in the A.R.S. 41-1035 rule impact reduction analysis elsewhere in this preamble. In that analysis, the Department finds that the statutory objectives, which are the basis of the rule, require the Department to establish cleanup standards that are protective of human health and the environment. The Department also is required to establish these standards based on the differing potential for occupants of the land to be exposed to contaminated soil at 2 types of property, residential and non-residential. Here, the Department is adopting requirements in the rule that are no greater than those identified in the statutory objectives set by the Legislature. Individual businesses, including small businesses, may experience differing costs when complying with the rule. These differing costs will result from site-specific remediation characteristics (for example, type of contaminant, land use). The rule allows all entities, including small businesses, to determine for themselves which standard and which method identified in the rule is the most cost effective to best meet their needs, given the site-specific remediation characteristics.

Costs and Benefits to Private Persons and Consumers

The costs of remediation borne by responsible parties will usually be passed on to their customers and consumers in general. On the other hand, the potential benefits to consumers are evident. Actual remediation, to the extent that it is promoted by this rule, carries many public health benefits to people who live and work in the vicinity of these sites. The health risks to exposed populations will diminish. The integrity of the environment will be maintained and, as such, the economic values of real properties, including those of adjacent property owners and homeowners, will be restored.

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A.R.S. § 41-1055(B)(6): Probable Effects on State Revenues

The Final Rule is anticipated to have no effect on state revenues. Most, if not all, of the cash flows for remediation will occur between responsible parties (whether public or private) and remediation consulting companies. In the case of ADHS, revenue received for risk assessment services will merely be reimbursement for costs incurred. No new net revenues are anticipated.

A.R.S. § 41-1055(B)(7): Less Intrusive or Less Costly Alternatives

The SRL standards, as calculated by ADHS, are based on principles accepted by the scientific community and EPA. Under the applicable statutory objectives discussed in the A.R.S. § 41-1035 analysis in this preamble and elsewhere, uniform standards must apply to all entities, whether they are public or private, small or large businesses. The question of costs revolves around contamination in site-specific cases, and what it costs to correct the contamination. The Department has provided alternatives for selection of remediation standards. This flexibility allows parties to choose the option that is most appropriate and cost effective for their individual purposes.

A.R.S. § 41-1055(C)

Data limitations are described in the section A.R.S. § 41-1055(B)(3), Cost-Benefit Analysis.

A.R.S. § 41-1035: Reduction of Rule Impact on Small Businesses.

A.R.S. § 41-1035 requires the Department to reduce the impact of a rule on the class of small businesses, if possible. The Department shall use 1 or more of the 5 methods defined in that section to reduce the impact, if the methods are legal and feasible in meeting the statutory objectives which are the basis of the rulemaking. The following analysis was performed on the 5 methods:

Compliance, Reporting, Scheduling, and Deadline Requirements.

Methods 1, 2, and 3 in A.R.S. § 41-1035 require the Department to identify compliance, reporting, scheduling, and deadline requirements contained in a rule and, when legal and feasible, to reduce, consolidate, or simplify them for applicants who fall within the class of small businesses. The rule does not set schedules or deadlines for achieving compliance. Compliance requirements in the rule stem from the establishment of risk-based standards. Reporting requirements are found in the: 1) Notice of Remediation; 2) VEMUR and VEMUR Cancellation; and 3) Letter of Completion. Each is discussed separately below.

Compliance: Risk-based Standards

The relevant statutory objectives require the Department to establish standards for soil remediation activities based on risk to human health and the environment. The statute also requires the Department to establish at least 2 categories of standards: residential and non-residential. The standards reflect the differing potential for occupants of land to be exposed to contaminated soil based on the use of land and not on the status or class of the entity performing the remediation.

The Department also must allow these standards to be met by either of 2 methods: pre-determined (determined by rule, or "off the shelf") and site-specific (determined by the entity performing the remediation or, "customized approach"). The Department has determined that: (1) the proposed rule establishes standards and categories according to minimum statutory compliance requirements; these requirements apply to all entities performing remediation whether or not they fall within the class of small businesses, and (2) establishment of additional categories of standards would result in the recognition of other land use categories only.

Reporting: The Notice of Remediation

The rule requires a Notice of Remediation be submitted to the Department by a person intending to conduct remediation activities in accordance with A.R.S. Title 49. The rule does not set a schedule or deadline for submission. The Notice of Remediation requirement is intended to provide information for the Department's Repository at an early stage of remediation activity. Submittal deadlines will be set by the regulatory program, not this rule. The Department has determined that the information required in the Notice of Remediation is the minimum required by the relevant statutory objectives to make the Repository useful.

Reporting: The VEMUR or VEMUR Cancellation

Not all entities governed by the rule will be required to file a VEMUR or a VEMUR Cancellation. A VEMUR is only required when a land owner chooses to remediate to the less protective, non-residential standard instead of the more protective, residential standard. It is the land owner, not the Department, who makes this choice. The relevant statutory objectives require the Department to sign the VEMUR, therefore, those who remediate to the non-residential standards must submit a minimum amount of information to obtain Department verification that the non-residential standards have been met. A land owner subsequently may submit a VEMUR Cancellation to the Department for verification that a property has been remediated to residential standards. The Department has determined that the proposed rule requires only the minimum amount of information required by the statutory objectives. Any change regarding information required for verification of the VEMUR or a VEMUR Cancellation could result in requiring more information than required by the rule.

Reporting: The Letter of Completion

The relevant statutory objectives encourage remediation of contaminated land. Not all remediation programs, however, provide for Departmental acknowledgment of remediation activities. Sometimes, entities might not receive evidence from the Depart-

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ment of successful completion of remediation. The Department has determined that some sort of Departmental acknowledgment of completion furthers the statutory objectives and will encourage parties to remediate. To this end, the rule allows anyone to request a Letter of Completion.

The Department has determined that a minimum amount of information is necessary to allow the Department to make a reasoned decision whether or not to issue the Letter of Completion. Reducing the level of required information could diminish the meaning and value of the resulting letter to an unacceptable level. The Department has determined that reducing or simplifying the reporting requirements for members of the class of small businesses could only cause the resulting Letter of Completion to fail in its essential purpose.

Performance Versus Design or Operational Standards

Method 4 in A.R.S. § 41-1035 requires the Department to identify design or operational standards contained in a rule and, when legal and feasible, to replace them with performance standards for applicants who fall within the class of small businesses. Design or operational standards are standards that specify how each step in a process shall be done and may or may not also specify the desired end result. Performance standards are standards that only specify the desired end result but do not specify exactly how that end result is to be achieved. The relevant statutory objectives require the Department to establish performance standards only, not design or operational standards. With the establishment of SRLs and site-specific remediation levels, the Department has established performance standards only. The rule leaves all other elements necessary to meet the performance standards to the person performing the remediation, subject only to certain statutory restrictions which have not been increased by this rule.

Rule Exemption for Small Businesses

Method 5 in A.R.S. § 41-1035 requires the Department to exempt small businesses from all requirements of the rule if legal and feasible. The Department has determined that the relevant statutory objectives require: 1) The rule to apply to all entities performing remediation whether or not they are small businesses; and 2) Remediation options available under the rule are based on land use and not whether the party performing remediation is a small business. The Department has set compliance, reporting, and performance requirements as low as permitted by statute for all parties performing soil remediation who are affected by the rule.

Findings

At each step in the process, the Department exercised whatever discretion the Legislature delegated by statute to reduce adverse impacts to all businesses, including small businesses, to the maximum extent permitted by the statutory objectives which are the basis of the rule. The Department finds, therefore, that it is not legal or feasible to reduce further the impacts of the rule to small businesses which may be affected by the rule.

9. A description of the changes between the proposed rules, including supplemental notices, and final rules (if applicable):

To increase the clarity and understandability of the rule, various grammar, punctuation, and stylistic changes were made throughout the rule. With regard to content changes, the Department received many comment letters regarding the rule. In analyzing and responding to comments and suggestions, the Department made changes to the rule which resulted in re-writing multiple provisions and sections. Because of the inter-relatedness of the rule sections and the fact that a single change in 1 section affected multiple sections, a detailed comparison between the proposed and adopted rule has less value than a narrative description of the issues which changed. This narrative description of the major changes can be found in section #6. In addition, a detailed description of these major issues as well as a discussion of other issues can be found in section #10 which describes comments received and the Agency's response.

The Final Rule was adopted by the Department on September 18, 1997, and was heard by the Governor's Regulatory Review Council (GRRC) on November 4, 1997. Following discussion at the hearing, the rule was tabled until the December 2, 1997, GRRC meeting. GRRC requested that ADEQ evaluate comments received at the meeting on 3 issues: 1) The polychlorinated biphenyl SRL; 2) The use of 1×10^{-6} as the point of departure for determining cumulative site-specific carcinogenic risk levels; and 3) Ecological risk. As a result, the Department held a Task Force meeting to discuss the issues. Changes made to the rule since adoption are discussed in section #6 and in section #10.

10. A summary of the principal comments and the agency response to them:

CHANGES MADE SINCE THE NOVEMBER 4, 1997, GOVERNOR'S REGULATORY REVIEW COUNCIL

The Final Rule was adopted by the Department on September 18, 1997 and was heard by the Governor's Regulatory Review Council (GRRC) on November 4, 1997. After discussion at the hearing, the rule was tabled until the December 2, 1997, GRRC meeting. GRRC requested that ADEQ evaluate comments received at the meeting on 3 issues: 1) The polychlorinated biphenyl SRL; 2) The use of 1×10^{-6} as the point of departure for determining cumulative site-specific carcinogenic risk levels; and 3) Ecological risk. On November 14, 1997, ADEQ held a Task Force meeting to discuss the issues. The following section explains changes made to the rule since adoption.

1. **The Polychlorinated Biphenyl (PCB) SRL**

ISSUE: When ADEQ adopted the rule, it deleted what it considered to be superfluous language that created an option to allow PCB cleanups subject to the Toxic Substances Control Act (TSCA) to meet the cleanup standards in federal regulations at 40

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CFR 761, Subpart G. At the GRRC hearing, commenters argued that the deletion of this option limited the ability of TSCA-regulated parties to remediate soil to the TSCA PCB cleanup standards. Additionally, the commenters argued that the SRLs were more stringent than federal standards and should be changed to 10 mg/kg for residential use and 25 mg/kg for non-residential use to be consistent with federal requirements. Subsequent to the GRRC hearing, the Department was advised by the Task Force that the USEPA Integrated Risk Information System (IRIS) contains updated cancer slope factors for PCBs and requested that the PCB SRLs be recalculated using the new data.

ANALYSIS: Although the Department does not believe the provision is necessary, the reference to TSCA PCB cleanup standards for TSCA-regulated spills will be reinserted into the rule. The replacement of this language should remove any unintended consequences that may have occurred as a result of its deletion. However, the Department did add to the replaced language a statement that the Department will be unable to issue a Letter of Completion for cleanups that attain TSCA standards rather than the remediation standards in this rule. This is due to the Department's inability to provide assurance that the USEPA will accept the cleanup as meeting all of their requirements.

The argument that the PCB SRLs in this rule were more stringent than federal requirements under TSCA was evaluated and found to be unsupported for the following reasons:

- 1) The TSCA cleanup policy typically applies only to PCB spills that occur during USEPA-authorized activities such as: use of electrical equipment, servicing of electrical equipment, and the storage for disposal of PCBs. Under TSCA, the USEPA also clearly excludes the application of the PCB cleanup standards for spills of material containing less than 50 ppm of PCBs, spills that occurred prior to May 4, 1987, spills that are regulated by more than 1 federal program, and other specific spill situations listed in the regulation.
- 2) The TSCA cleanup policy is based on limitations of property use that are not available under state law. TSCA recognizes 3 uses of property: nonrestricted access (includes residential and commercial use), electrical substations (with walls and fences which restrict access), and other restricted (nonsubstation) access (requires man-made or natural barriers such as fences or cliffs). Also, all property within 0.1 km of nonrestricted access areas is considered nonrestricted access and must be cleaned up to the more stringent cleanup requirements.
- 3) The TSCA PCB cleanup requirements are based on the volume of spilled material and the concentration of PCBs in the spilled material. For low volume (less than 1 pound) low concentration material (less than 500 ppm PCBs) spills in soil, the entire area of the spill plus 1 lateral foot must be excavated and the site restored using clean soil containing less than 1 ppm PCBs. Only in the case of high concentration spills and high volumes does TSCA provide alternative cleanup standards based on property use. Again, the standards are not equivalent to SRLs. For nonrestricted access areas, TSCA requires excavation of the top 10 inches of soil and restoration with clean soil containing less than 1 ppm PCBs while the soil remaining at depth may contain up to 10 mg/kg PCBs. For restricted (nonsubstation) access areas, cleanup can be to 10 mg/kg as long as the area is greater than 0.1 km from a nonrestricted access area. For electrical substations located greater than 0.1 km from a nonrestricted access area, the responsible party has a choice between cleanup to 25 mg/kg; or cleanup to 50 mg/kg provided label or notice is visibly placed in the area.

The Department believes that both the methodology and the cancer risk used in deriving the state PCB SRLs are well founded. However, the Department agrees that a technical correction to the PCB SRLs is appropriate. As detailed in the 2nd document attached to the Preamble, the SRL calculations use USEPA sources for the toxicological constants with IRIS being the source of preference. Therefore, the Department will modify the adopted PCB SRLs to reflect the most recent scientific data. Although the new EPA data will result in a change to the SRLs, the resultant cancer risk has not changed.

RESPONSE: R18-7-205 is amended as follows:

- C. A pre-determined contaminant standard established by federal law or regulation may be used for polychlorinated biphenyl cleanups regulated pursuant to the Toxic Substances Control Act (TSCA) at 40 CFR 761.120 et seq., however, the Department has no regulatory authority to issue a Letter of Completion in TSCA-regulated cleanups.

In addition, the PCB SRLs in Appendix A are revised as follows: residential - 2.5 mg/kg; and non-residential - 13 mg/kg.

2. Use of Point of Departure For Determining Site-Specific Carcinogenic Risk Levels

ISSUE: Commenters indicated that the use of 1×10^{-6} as the point of departure for determining site-specific carcinogenic risk levels in R18-7-206(E) is not authorized by A.R.S. § 49-152. They stated that the point of departure creates a presumption that 1×10^{-6} is the appropriate carcinogenic risk level unless a risk assessment demonstrates otherwise. The commenters stated that A.R.S. § 49-152(B)(2) only incorporates the range of risk levels set forth in 40 C.F.R. § 300.430(e)(2)(i)(A)(2) and does not give a preference for any particular risk level within the range. Finally, several comments indicated that the use of 1×10^{-6} as the point of departure creates a conflict with ADEQ's decision to use a 1×10^{-5} carcinogenic risk level to establish SRLs for most substances.

ANALYSIS: The Department believes it has authority under A.R.S. § 49-152 to set a point of departure risk value from which adjustments can be made. In addition, the Department does not agree that the use of a point of departure creates a conflict with the SRLs. The SRLs are intended to be cleanup levels which are protective in every situation and, as such, must be conservative. The Department chose to balance the conservatism of the SRL calculations by making a policy decision to use 1×10^{-5} as the excess lifetime cancer risk for Classes B and C carcinogens.

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However, subsequent to the GRRC hearing, the Department was advised by the Task Force that the use of 1×10^{-6} as the point of departure is more appropriately addressed in guidance as long as the Department retains the authority under R18-7-206(E) to require cleanups to 1×10^{-6} or 1×10^{-5} for both residential and non-residential cleanups based on site-specific conditions. As a result, the Department is deleting the "point of departure" language from the rule, but is adding language which makes it clear that the remediating party and ADEQ shall select the excess lifetime cancer risk between 1×10^{-6} to 1×10^{-4} based upon the factors enumerated in R18-7-206(E).

RESPONSE: R18-7-206(E) is revised as follows:

- E. A person conducting a remediation to a residential or a non-residential site-specific remediation level shall remediate the contaminants in soil to a cumulative excess lifetime cancer risk between 1×10^{-6} and 1×10^{-4} and a Hazard Index no greater than 1 taking into account the factors enumerated in this subsection. The person conducting a remediation, and the Department prior to issuing a Letter of Completion, shall select the excess lifetime cancer risk between 1×10^{-6} and 1×10^{-4} based upon the following site-specific factors:
1. The presence of multiple contaminants.
 2. The existence of multiple pathways of exposure.
 3. The uncertainty of exposure.
 4. The sensitivity of the exposed populations.
 5. Other program-related laws and regulations that may apply.

R18-7-201. DEFINITIONS

1. Anthropogenic Background

ISSUE: The proposed definition of "background" ignores the use of anthropogenic background concentrations for soil remediation levels. Not only does this choice affect the use of background concentrations as a remedial standard, but it also impacts the proper assessment of risks at a site and may force parties to remediate chemicals present on a site from off-site sources or from general human activity. A large number of soil cleanups occur in urban areas affected by general human activities not linked to operations or activities on the site being remediated. If anthropogenic background concentrations are not considered, the remedial level for a chemical such as benzo(a)pyrene becomes unacceptable because that level is below background from motor vehicles and other industrial sources. Contaminant contributions from society in general, such as from industrial operations, automobiles, agricultural activities, and other human industrial and non-industrial sources, should be considered in determining background for purposes of establishing an appropriate cleanup level.

Moreover, this definition is not consistent with EPA's definition of background chemicals, which includes both naturally occurring and anthropogenic chemical constituents. The purpose of background sampling is to distinguish site-related contamination from naturally occurring or other non-site-related levels of chemicals. This delineation is critical as site cleanups should not and cannot be responsible for the reduction in non-site-related concentrations of chemicals in soil (or other media). The agency should consider the examples of polycyclic aromatic hydrocarbons (PAHs) and dioxins that represent chemical classes that: 1) are both naturally occurring and anthropogenic; and 2) have pre-determined soil standards below background levels. It is recommended that ADEQ revisit their definition of background chemicals and consider the EPA's (and other states') definitions.

ANALYSIS: Anthropogenic contaminants by definition are the result of human activity. The Cleanup Standards/Policy Task Force (Task Force) agreed to limit the definition of background to concentrations of contaminants found naturally in the environment. This clearly excludes PAHs and dioxins that commonly are found in the environment but are the result of human activities.

The Department acknowledges that limiting background to naturally occurring concentrations differs from EPA's definition. However, the Department is consistent with EPA in limiting cleanups to only "site related" contamination. Therefore, only those contaminants suspected to have been released and subject to A.R.S. Title 49 authority must be assessed and remediated. For example, contaminants in soil that are the result of legal applications of pesticides and biosolids are not subject to A.R.S. Title 49 and are not affected by the standards in this rule (Please see Issue #9 in R18-7-202). However, a property owner will be required to demonstrate the attainment of remediation standards under this rule if a Letter of Completion is desired.

RESPONSE: No change to the rule.

2. Background

ISSUE: The definition of "Background" seems unclear. Of specific concern are the words "similar soils" which lack orientation. The sentence could be clarified as follows:

"Background" means the 95th percentile upper confidence limit of the distribution of the concentration of a naturally occurring contaminant in similar soils within close proximity to, but not affected by, a release and that are of similar characteristics to the soils affected by the release.

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ANALYSIS: The Department agrees that the proposed definition was unclear. Therefore, the definition has been simplified. Additionally, the requirements for determining the naturally occurring concentration of a contaminant have been moved to R18-7-204(B).

RESPONSE: R18-7-201 is revised as follows:

"Background" means a concentration of a naturally occurring contaminant in soils.

In addition, R18-7-204(B) is revised as follows:

A person who conducts a remediation to a background concentration for a contaminant shall establish the background concentration using all of the following factors:

1. Site-specific historical information concerning land use.
2. Site-specific sampling of soils unaffected by a release, but having characteristics similar to those of the soils affected by the release.
3. A statistical analysis of the background concentrations using the 95th percentile upper confidence limit.

3. Cancer Group

ISSUE: The definitions of "Cancer Group" and "Carcinogen" or "Carcinogenic" may be affected by EPA's proposed cancer guidelines. The proposed guidelines eliminate the weight-of-evidence cancer groupings being used in ADEQ's proposed definitions. The EPA proposal recommends using 3 cancer groupings: known/likely, cannot be determined, and not likely. Such a change would combine Cancer Groups A and B into 1 group which would impact the definition of carcinogen/carcinogenic and selection of a risk level based on cancer group. The "Carcinogen" definition could be revised to eliminate reference to the weight-of-evidence cancer group or will need to be revised in the event the proposed guidelines are finalized.

ANALYSIS: The Department is aware of the proposal by the EPA to revise the current cancer groupings. The new classifications will be narrative and will not precisely correspond to any of the current EPA classifications. However, the A through E classification is the cancer designation currently used by the EPA Region IX in developing the Preliminary Remediation Goals (PRGs) as well as in the EPA Risk Assessment Guidance for Superfund. The ND classification included in the proposed definition has been removed for the Final Rule.

Discussions with EPA Region IX Technical Support Team staff indicate that the new carcinogenicity classifications will be phased in over the next several years. There is no set implementation date. The EPA will be evaluating which chemicals should be reviewed 1st and will then conduct a resource check to prioritize the chemicals. This process will include a period of public comment. Once priority chemicals are chosen, technical staff will evaluate the data and begin classifying particular chemicals. Resource limitations will determine the rate at which chemicals will be reclassified and several years will likely pass before all chemicals are reclassified. Once the list of chemicals has been reclassified by the EPA, the Department will amend the rules as necessary.

RESPONSE: R18-7-201 is revised as follows:

"Cancer Group" means a category of chemicals listed by a weight-of-evidence assessment by the United States Environmental Protection Agency to evaluate human carcinogenicity. Based on this evaluation, chemicals are placed in 1 of the following categories: A - known human carcinogen; B1 or B2 - probable human carcinogen; C - possible human carcinogen; D - not classified as to human carcinogenicity; and E - evidence of non-carcinogenicity in humans.

4. Contaminant

ISSUE: The proposed definition of "contaminant" is far too broad because it includes any substance which is "suspected" of having an adverse impact on public health or the environment. It would be helpful to provide a definition that addresses whether the mere existence of a contaminant above detectable levels is considered contamination or whether the contaminant level must exceed a certain threshold, such as the SRL or a fraction thereof, before the requirements to address "contamination" apply. The best example of this is the requirement to define vertical and lateral extent of contamination. With such a definition, the terms "contaminant" and "contamination" should be used throughout the rule according to the intended meaning.

ANALYSIS: The Soil Remediation Standards Rule is intended to address how clean the soil must be to protect human health and the environment. The requirement to address contamination under this rule is determined by the relevant Departmental program, not by the mere presence of detectable levels of contaminants in soil. Additionally, the rule does not establish the requirements for characterization of a site. The Department currently is developing guidance for site characterization activities that will provide more assistance.

Hundreds of potentially toxic chemicals are currently in use that do not have SRLs due to inadequate toxicity information. The Department believes that the lack of toxicity information for a chemical does not eliminate it as a potential hazard. Therefore, these chemicals should not be eliminated as potential contaminants. However, the Department does not want the definition to include benign substances. As a result, the definition is changed to include any substance regulated under the programs listed in R18-7-202(A) and R18-7-202(B). This will allow the remediation of any substance not otherwise covered by the definition, but which clearly presents a hazard.

RESPONSE: R18-7-201 is revised as follows:

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"Contaminant" means a substance regulated by the programs listed in R18-7-202(A) or R18-7-202(B).

5. Deterministic Risk Assessment Methodology

ISSUE: This definition appears to be describing a "Deterministic risk assessment" rather than a methodology. As the rule uses the word "methodology" in R18-7-205(C)(1), the definition should be revised to:

"Deterministic risk assessment methodology" means preparation of a risk assessment using a specific set of input variables, exposure assumptions, and toxicity criteria represented by point estimates for each receptor evaluated which results in a point estimate of risk.

ANALYSIS: The Department agrees that the definition should describe a methodology.

RESPONSE: R18-7-201 is revised as follows:

"Deterministic Risk Assessment Methodology" means a site-specific human health risk assessment, performed using a specific set of input variables, exposure assumptions, and toxicity criteria, represented by point estimates for each receptor evaluated, which results in a point estimate of risk.

6. Ecological Receptor; Definition is too Broad

ISSUE: The Department received numerous comments on the definition of "ecological receptors" as well as the condition in R18-7-203(B)(5). Some commenters questioned whether the rule should include any sensitive environment provisions, while others stated that the rule should include additional provisions. These comments can be found in Issue #12 in R18-7-203. This section will address specific comments on the definition only.

Several commenters indicated that defining an "ecological receptor" as lands greater than 1 acre containing a population of plants or animals, or both, and associated habitat is so broad that virtually every remediation will require an ecological risk assessment. Any open acre of land in the State of Arizona likely contains "a population of plants or animals, or both, and associated habitat." The practical result of this definition is that every cleanup encompassing more than 1 acre will require a costly ecological risk assessment. This will result in an inappropriately large number of sites which need to conduct an ecological risk assessment even if there are no ecological values that the Task Force felt were worth protecting.

Several others indicated that the definition does not identify a "receptor" other than the "land." Unless a "receptor" other than land is identified, such as a person, plant or animal, the definition is inappropriate at best. It is also unclear whether "lands" includes marshes and ponds.

Other commenters stated that the 1 acre size limitation seems arbitrary. The potential for adverse impacts to ecological receptors by contamination at a site is not determined by site size. To what does the 1 acre limitation refer, facility boundaries, site boundaries, lateral extent of contamination? Ecological receptors are those receptors both on-site and off-site which contact and subsequently are adversely impacted by contaminants which originated from the site. Ecological risk assessment and risk management should focus on individuals, populations, communities, habitats, ecosystems, critical resources, and other key components of the ecological system. These considerations should not be limited by area or location. For example, ephemeral streams and wetlands in desert environments may often be smaller than 1 acre.

In addition, 1 commenter indicated that large public or private lands, such as Department of Defense installations, may contain numerous discrete areas of concern within 1 parcel of land owned by a single "Person" (per the definition contained in R18-7-201). The definition indicates that lands smaller than 1 acre in size are not considered ecological receptors. This definition (specifically "lands smaller than 1 acre") is of concern because each area of concern may be considered an individual site or "lands." Under the above described scenario, the "person" owning the land would not be required to assess the ecological risk at any 1 site or "lands," even though a significant risk to the entire parcel may be present.

The Department also received comments stating that "ecological receptors" should be included in the definition. Several commenters indicated that the definition should include language specifying that plants and animals must actually be exposed to soil contaminants to become receptors. In addition, they stated that the definition should be limited to sites on which there are ecological values that actually justify protection. Thus, the definition should be limited to property that contains wetlands, riparian habitat, or endangered species. Including the habitat for threatened or endangered species is enormously broad given the vast stretches of the State which have been designated as critical habitat under the Endangered Species Act. The fact that critical habitat includes private lands also is problematic. To make the definition meaningful and to make it consistent with what was thought to be previously agreed upon by the Task Force, the commenter proposed the following definition which limits the requirement to perform an ecological risk assessment:

"Ecological Receptor" means a plant or animal, or both, that, as a result of bioaccumulation or other route of exposure, is adversely impacted by a contaminant on the site being remediated and which is either a federally listed endangered species or the site being remediated is a riparian habitat.

A simpler alternative would be to eliminate the definition entirely and place explicit limits on the requirement for an ecological risk assessment rather than imply those limits through a definition.

In contrast, other commenters indicated that the definition should be broadened to include individual organisms and ecosystems. They stated that consideration of individual organisms should not be limited to members of species recognized by law as endangered or threatened. Organisms which are representative of a portion of an ecosystem should be considered potential receptors.

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ANALYSIS: The Department disagrees that under the proposed language, every site greater than 1 acre would require an ecological risk assessment. Criteria were listed in R18-7-203(B)(5) to allow persons to screen their sites to determine if further evaluation of ecological risk is necessary. The Department expected that all 3 criteria would have to apply to a site before concern was warranted and that few sites would require further assessment.

In addition, the Department disagrees that the Task Force agreed that some ecological values were not worthy of protection or agreed on any particular definition for "ecological receptors." In fact, the Department held a number of meetings with Task Force members and other stakeholders on this issue and there was strong support to include an ecological component in the rule. This is further documented in the Compromise Proposal language developed by the Task Force and A.R.S. §49-152(A) that refers to soil remediation levels that protect public health and the environment.

However, the Department agrees that the 1 acre limitation is arbitrary. The Department also agrees that the definition may require a large number of sites to demonstrate that ecological receptors have not been impacted by contaminants.

The Department reviewed the suggestions to modify or delete the definition of "ecological receptor" and the requirement to evaluate potential impacts to ecological receptors. The suggested language on the evaluation of potential impacts is addressed in Issue # 12 in R18-7-203. The suggested language on the definition recommends limiting the focus to riparian habitats and to endangered species. A.R.S. § 49-152(A) does not give the Department the discretion to ignore or exclude any ecological receptors or ecosystems. In addition, the Department believes the proposal does not reflect the Task Force's desires. Therefore, the suggested language was not adopted. Other comments suggested adding individual organisms and ecosystems. The Department agrees that these should be included in the definition.

The Department is revising the definition of "ecological receptor" and the approach for dealing with ecological impacts. Please see Issue # 12 in R18-7-203 for a complete description.

RESPONSE: R18-7-201 is revised as follows:

"Ecological Community" means an assemblage of populations of different species within a specified location in space and time.

"Ecological Receptor" means a specific ecological community, population, or individual organism protected by federal or state laws and regulations, or a local population which provides an important natural or economic resource, function, and value.

"Ecological Risk Assessment" is a scientific evaluation of the probability of an adverse effect to ecological receptors from the exposure to a specific type and concentration of a contaminant. An ecological risk assessment contains 4 components: identification of potential contaminants; an exposure assessment; a toxicity assessment; and a risk characterization.

"Population" means an aggregate of individuals of a species within a specified location in space and time.

7. Frequent and Repeated Contact

ISSUE: A.R.S. § 49-151 uses the phrase "frequent and repeated contact" to distinguish between residential and non-residential exposures. Therefore, the meaning of the phrase is critical to the application of this rule and should be defined.

ANALYSIS: A.R.S. § 49-151(3) defines "residential use" as "those uses of remediated property upon which there are dwellings where the residents are reasonably expected to be in frequent, repeated contact with soil, or other uses where natural persons are reasonably expected to be in similar contact, such as child care centers and elementary schools." This definition was discussed at length in stakeholder meetings. It was agreed that frequent and repeated contact was self-explanatory and could not be refined without compromising the intent to maintain flexibility. The term is intended to allow unrestricted activities such as gardening, digging, and playing that can result in direct contact with soils over the majority of the year. Establishing a discrete time frame for exposure may have unexpected results, therefore, the Department decided to leave the term undefined to provide maximum flexibility.

RESPONSE: No change to the rule.

8. Hazard Index

ISSUE: Hazard index is used in the rule and should be defined.

ANALYSIS: The Department agrees and has added a definition for "hazard index." In addition, a definition for "hazard quotient" has been added.

RESPONSE: R18-7-201 is revised as follows:

"Hazard Index" means the sum of hazard quotients for multiple substances or multiple exposure pathways, or the sum of hazard quotients for chemicals acting by a similar mechanism or having the same target organ.

"Hazard Quotient" means the value which quantifies non-carcinogenic risk for 1 chemical for 1 receptor population for 1 exposure pathway over a specified exposure period. The hazard quotient is equal to the ratio of a chemical-specific intake to the reference dose.

9. Migrate or Migration

ISSUE: The definition of "Migrate" or "Migration" should include the movement of contaminated soil particles from the point of release by wind or other mechanisms.

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ANALYSIS: The Department agrees that other mechanisms should be included.

RESPONSE: R18-7-201 is revised as follows:

"Migrate" or "Migration" means the movement of contaminants from the point of release, emission, discharge, or spillage: through the soil profile; by volatilization from soil to air and subsequent dispersion to air; and by water, wind or other mechanisms.

10. Non-Residential Site-Specific Remediation Level; Inconsistency With Statute

ISSUE: The Department received several comments on the proposed definition of "non-residential site-specific remediation level." The commenters expressed concern that the definition was inconsistent with the statute and ADEQ's own interpretation of that statute. Under the proposed definition, a site-specific risk assessment must demonstrate the level of residual risk for a carcinogen in soil no greater than 1×10^{-4} . However, the language of A.R.S. § 49-152(B)(2) declares that remediation to non-residential levels requires a Voluntary Environmental Mitigation Use Restriction (VEMUR) if such remediation results in a residual risk "of carcinogenic health effects *greater than* the range of risk levels set forth in 40 CFR 300.43(e)(2)(1)(A)." The range of excess cancer risk levels which, if exceeded, will require a VEMUR is stated in the EPA regulation as "between 10^{-4} and 10^{-6} ." In other words, the proposed rule declares that a non-residential soil cleanup level for a carcinogen cannot exceed 1×10^{-4} . However, the relevant statute explicitly allows a residual risk greater than 1×10^{-4} as long as a VEMUR is filed for the affected property.

The commenters argued that statutory language directly tracks the language of the November 1994 "Compromise Proposal" on which it was based (see description of Categories 2(a) and 2(b) of the Proposal). Indeed, in its preamble to the proposed Interim Soil Remediation Standards Rule, ADEQ seems to adopt this interpretation of the statute: "For a non-residential site, the Department may approve an alternative carcinogenic risk level greater than 1-in-10,000 and a non-cancer hazard index of greater than 1, if a proper demonstration is made that site-specific conditions, potential pathways of exposure, and institutional security and engineering safeguards are sufficient to protect public health and the environment." See Preamble dated July 21, 1995.

The commenters stated that defining to what level remediation is to occur was an important issue in the development of the Compromise Proposal. As it finally came out, there was a deliberate attempt to create a regulatory structure for remediation that would be sufficiently flexible to allow the consideration of site-specific factors and the latest scientific information. The structure embodied in the Compromise Proposal and incorporated into the applicable statutes has not been entirely followed in the definitions in the proposed rule.

In the past it was clear that the Department agreed with this interpretation of the clear language of the statute, but Department personnel asserted that being allowed to exceed the 1×10^{-4} and hazard index levels was predicated upon a showing that, for a site, there were adequate institutional or engineering controls available to protect public health and the environment. While the statute does not necessarily require this result, the following language is acceptable since it merely restates the Department's previous position in this matter:

"Non-Residential Site-Specific Remediation Level" means a level of contaminants in soil which will result in an excess lifetime cancer risk level between 1×10^{-4} and 1×10^{-6} and Hazard Index of no greater than 1 based on non-residential exposure assumptions. A greater excess lifetime cancer risk level or hazard index may be approved as a non-residential remediation level on a case-by-case basis if site-specific conditions and institutional or engineering controls are sufficient to protect public health and the environment.

ANALYSIS: The Department has established the risk that must be achieved by a person conducting a remediation based on a site-specific risk assessment: a level of contaminants in soil which will result in an excess lifetime cancer risk between 1×10^{-6} and 1×10^{-4} and a Hazard Index no greater than 1. The establishment of these risk levels is mandated by A.R.S. § 49-152, carries out the intent of the Soil Cleanup Standards/Policy Task Force, and is consistent with the range of risk used to calculate predetermined risk-based standards, the SRLs.

Subsection (A) of A.R.S. § 49-152 provides that "the director shall approve remediation levels calculated in accordance with this subsection . . ." Subsection (A) sets forth 2 methods for identifying a remediation level: (A)(1) a predetermined risk based standard; and (A)(2) a level derived from a site-specific risk assessment. Pursuant to Subsection (A)(1), the Director established risk levels (1×10^{-6} and 1×10^{-5}) to be factored with residential and non-residential exposure assumptions in calculating residential and non-residential SRLs. Pursuant to Subsection (A)(2), the Director established a range of risk levels (1×10^{-6} to 1×10^{-4}) for site-specific remediation levels derived from a risk assessment, but the determination of the exposure at each site is left to guidance.

The Director selected risk levels for the SRLs and for site-specific risk assessments that would provide similar protection to public health. The range of site-specific risks includes 1×10^{-4} to account for total site risk, which is not considered in the SRLs.

The Department disagrees that the proposed definition of "Non-Residential Site-Specific Remediation Level" contradicts the VEMUR subsection, A.R.S. § 49-152(B). First, subsection (B) must be kept in context. This subsection addresses when a VEMUR must be recorded. It does not establish what remediation levels are allowable, as does subsection (A), described above.

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Second, subsection (B) must be interpreted keeping in mind the intent of the Task Force that a party be permitted to remediate to a less stringent standard, non-residential, so long as that party records a VEMUR, which provides public notice that an area of the property is limited to non-residential uses. The language of the VEMUR statute repeats this intent: "remediate the property to nonresidential uses" and "limiting . . . the area . . . to nonresidential uses." A.R.S. § 49-152(B). Similarly, subsection (E) of the statute prescribes the language that must be placed on the VEMUR: "The undersigned voluntarily agrees to limit and restrict the use of the remediated portion of the property to nonresidential uses." "Nonresidential use" is defined as "other than residential uses", which takes into account the residential exposure assumptions of residents having frequent and repeated contact with the soil. A.R.S. § 49-151. If property is remediated using nonresidential exposure assumptions, under either the SRLs or a site-specific risk assessment, a VEMUR is required.

The error of relying on the VEMUR statute to establish remediation levels is demonstrated by the commenters' position that the VEMUR statute allows contamination to remain that exceeds a risk of 1×10^{-4} , (that is, exceeding non-residential levels). The Task Force did not intend that a party could file a VEMUR and use it as an excuse not to remediate the property. The Task Force and the statute establish 2 levels of remediation, residential and non-residential. Property that is not remediated to at least the non-residential level is unsafe for any use.

The 1994 "Compromise Proposal" cited by the commenters does not support the proposition that remaining contamination may exceed non-residential levels. The "Compromise Proposal" represented views of the Task Force early in the process, before several issues had been resolved, for example, the issue of leachability to groundwater. Nevertheless, it is clear that even where engineering and institutional controls were to be used on non-residential sites, it was necessary that these controls "achieve protection within the acceptable risk range of 10^{-4} to 10^{-6} at the point of potential exposure." (See INTERIM SOIL REMEDIATION POLICY, 0052.000, issued July 27, 1995). Because another provision of the rule explicitly allows site-specific remediation levels to be attained through the use of institutional and engineering controls, the Department will not modify the definition of "Non-Residential Site-Specific Remediation Level" to reiterate this feature (Please see Issue #13 in R18-7-205).

Several commenters mentioned that even though the statute states "the range of risk levels", they believed that 1×10^{-4} was the only risk level that required a VEMUR. Because the legislature used the phrase "range of risk levels" rather than stating " 1×10^{-4} " the Department believes the legislature intended that a VEMUR was required when contamination at the property exceeds the risk level that is selected by the Department from within the range of 10^{-6} to 10^{-4} , considering site-specific factors.

Third, the Department's position on when a VEMUR should be filed is also supported by Subsection (C), which prescribes when a VEMUR may be cancelled. This subsection allows for cancellation of the VEMUR if contamination meets pre-determined residential standards, or if contamination meets the residential site-specific remediation level. The site-specific remediation level must result in a Hazard Index less than or equal to 1 and a carcinogenic risk less than the site-specific risk selected from the range. In other words, if contamination at the site does not exceed the pre-determined or site-specific levels calculated for residential exposure, it is appropriate to file a notice cancelling the VEMUR, which has restricted the site to non-residential use.

RESPONSE: No change to the rule.

11. Non-Residential Site-Specific Remediation Level; Determination of Appropriate Risk Within Range

ISSUE: It is unclear how ADEQ will make the determination as to the appropriate cleanup level (that is, where within the range of lifetime cancer risk levels between 1×10^{-4} and 1×10^{-6}) and how the factors contained in R18-7-109(D)(1) will be evaluated. In fact, the evaluation criteria to be used in determining the appropriate cleanup level appears to be somewhat qualitative in nature. Because of the vast differences in remedial costs depending on the cancer risk level applied within the above range, those responsible for cleanup will usually push for the lower (less protective) level. In light of this, why not set the same default acceptable lifetime cancer risk that was used for R18-7-201(25) to be utilized in evaluating the site specific exposure issues necessary to set an appropriate site-specific non-residential cleanup level, and leave the Director some room to accept a lesser cleanup standard (for both 201(18) and (25)) in isolated circumstances? This should promote consistency and may address some of the comments regarding artificially "capping" the cleanup (that is, not below 1×10^{-4} or above 1×10^{-6}) regardless of the "best science available."

ANALYSIS: As stated in the previous issues, A.R.S. § 49-152.B(2) and C(2) reference the range in 40 CFR 300.430(e)(2)(I)(A)(2). That citation requires EPA to consider carcinogenic risk between 1×10^{-6} and 1×10^{-4} when selecting a remedy under Superfund. It also requires EPA to use 1×10^{-6} as the point of departure for determining carcinogenic risk and allows site-specific factors to be used to move towards 1×10^{-4} . This means that the risk level will be assumed to be 1×10^{-6} unless site-specific factors indicate that a different risk level within the range of 1×10^{-6} and 1×10^{-4} is more appropriate. The factors include: the presence of multiple contaminants; the existence of multiple pathways of exposure; the uncertainty of exposure; the particular sensitivity of exposed population; and other program factors.

The Department will use a similar approach to EPA's in making the decision on the appropriate carcinogenic risk level. As such, R18-7-206 is revised to specify the factors that will be used by the Department. Additional guidance on application and evaluation of the factors will be provided in the Department's guidance on risk assessments.

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This rule applies to all soil remediation programs at ADEQ. The definitions of residential and non-residential site-specific remediation levels allow the Department to consider risks within the range specified. The Department believes it is inappropriate for this rule to specifically site the criteria that should be used to select a remedy under WQARF. However, the rule has been revised to allow consideration of other program-related factors in the determination of the appropriate risk within the range.

RESPONSE: R18-7-206 is revised as follows:

E. A person conducting a remediation to a site-specific remediation level shall remediate the contaminants in soil to an excess lifetime cancer risk between 1×10^{-6} and 1×10^{-4} and a Hazard Index no greater than 1. The excess lifetime cancer risk for the site-specific remediation level shall be determined using 1×10^{-6} as the point of departure. The excess lifetime cancer risk may depart from 1×10^{-6} based upon the following site-specific factors:

1. The presence of multiple contaminants.
2. The existence of multiple pathways of exposure.
3. The uncertainty of exposure.
4. The sensitivity of the exposed population.
5. Other program-related laws and regulations that may apply.

12. Nuisance

ISSUE: The meaning in A.R.S. § 49-141 is too broad to be useful for an owner or operator, or both, in determining whether or not a release could pose a nuisance. In fact, none of the conditions under environmental nuisances apply to this rule. The ADEQ should provide or develop guidance specific to this rule for definition of a nuisance. A subcommittee of the Task Force was formed for this purpose and recommendations were provided. These recommendations should be considered by the ADEQ.

ANALYSIS: The Department agrees that A.R.S. § 49-141 has limited applicability for the Soil Remediation Standards Rule. The public nuisance conditions under A.R.S. § 36-601 also have limited applicability for the rule. The Department agrees that guidance specific to this rule for definition of a nuisance would be helpful. However, there was no Task Force consensus on the guidance drafted by the Nuisance/Odor Working Group.

The Working Group confined its efforts to odors emanating from contaminated soils; particularly from hydrocarbons. The Working Group recognized the importance of site-specific factors such as the physical properties of the contaminant and the soil, the concentration and location within the soil, as well as human activities on or near the site when assessing the potential for a nuisance to occur. Because sensitivity to odors varies widely and causes the evaluation of nuisance to be very subjective, the condition that soil concentrations remaining in soil after remediation must not cause a nuisance is deleted from R18-7-203. (Please see Issue #11 in R18-7-203). However, a provision will be added to the rule that will allow the Department to require further action if a nuisance is caused by contaminants remaining in the soil. In addition, the Department is adding another statutory citation for regulating odor to the definition of nuisance.

RESPONSE: R18-7-201 is revised as follows:

"Nuisance" means the activities or conditions which may be subject to A.R.S. §§ 49-141 and 49-104(A)(11).

In addition, R18-7-202 is revised as follows:

F. Nothing in this Article limits the Department's authority to establish more stringent soil remediation levels in response to:

1. A nuisance.

13. Probabilistic Risk Assessment Methodology

ISSUE: The definition of "Probabilistic risk assessment methodology" appears to be describing a "Probabilistic risk assessment" rather than a methodology. For the same reasons related under "Deterministic risk assessment methodology" above, a possible revision would be:

"Probabilistic risk assessment methodology" means preparation of a risk assessment, using probability distributions of input variables and exposure assumptions which take into account the variability and uncertainty of these values, which results in a range or distribution of possible risk estimates.

ANALYSIS: The Department agrees that the definition should describe a methodology.

RESPONSE: R18-7-201 is revised as follows:

"Probabilistic Risk Assessment Methodology" means a site-specific human health risk assessment, performed using probability distributions of input variables and exposure assumptions which take into account the variability and uncertainty of these values, which results in a range or distribution of possible risk estimates.

14. Residential Site-Specific Remediation Level

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ISSUE: The Department received numerous comments that the proposed definition contradicts the applicable statutory language and ADEQ's past interpretations of that statute in 2 respects. Several commenters indicated there is no statutory authority to prohibit the use of institutional or engineering controls to achieve residential cleanup levels. The purpose of the statute and the implementing rules is to establish cleanup levels. It is not to dictate what technologies may be used to achieve those levels. If the most cost-effective technology for achieving a particular cleanup level is an institutional or engineering control, it is improper for ADEQ to ban the use of that technology in advance. For example, an engineering control might include a limitation on access to contaminated property so that a party would not have actual exposure to elevated concentrations of volatile contaminants on that property. Although, as a matter of theory, the exposure to such contaminants might not fall within the appropriate range *in situ*, the actual exposure is well within the residential use range.

Others stated that prohibiting any particular technology also contradicts ADEQ's agreement to and adoption of the 1994 Compromise Proposal. The Site-Specific Risk-Based Standards description explicitly characterizes "Institutional Controls" as allowable remediation technologies under *both* categories 2(a) and 2(b) for achieving site-specific remediation levels. There is absolutely no distinction made in the description of the categories between whether the institutional and engineering controls are to be used to achieve residential or non-residential cleanup levels.

Additional comments indicated that it is appropriate to allow engineering controls for residential site-specific remediation levels only if accompanied by a VEMUR or some other effective means of providing notice of the existence of contaminants above the residential remediation level. In addition, the notice should address the maintenance of the engineering controls to reduce the risk of exposure to these contaminants.

Several other comments were received on the requirement that the levels of contamination in soil cannot result in an excess lifetime cancer risk level of 1×10^{-6} for Class A carcinogens. The applicable statute declares that a VEMUR *shall* be canceled, that is, a property is appropriate for residential use, if the property has been remediated to a level that presents "a risk-estimate of carcinogenic health effects *equal to or less than* the range of risk levels in" the EPA regulation cited earlier, that is, between 10^{-4} and 10^{-6} . There is nothing in the statutory language that authorizes ADEQ to ignore the statutorily-dictated range of acceptable cancer risk levels for a residential remediation nor restrict that range to a single risk level of 1×10^{-6} for a particular class of substances. Had the Legislature intended to make a distinction between categories of carcinogens for the purpose of defining acceptable risk level for residential uses in site-specific risk assessments, it could have done so. It did not and ADEQ has no authority to do so in these proposed rules. In addition, the proposed definition limits ADEQ's ability to make the risk management decisions which EPA makes, and fails to consider the mandatory requirements of WQARF that remedial actions must be practicable, reasonable, necessary, cost-effective and technically feasible.

Others stated that such an interpretation of the statutory language is also inconsistent with ADEQ's previous interpretation of the same language. In the draft of its Interim Soil Remediation Policy of April 21 and May 18, 1995, ADEQ states that the Category 2(a) remediation target levels for carcinogens for both residential and non-residential uses is between 10^{-4} to 10^{-6} . In its July 21, 1995 Preamble to the Interim Soil Remediation Standards Rule, ADEQ stated that: "If the remediation level is less protective than 1×10^{-6} , the land use shall be restricted to non-residential use, unless a proper demonstration is made that the risk level is equivalent to residential protection." Commenters argued that even the quoted language contradicts the statute in the sense that under the statutory language a demonstration that the residual risk is in the range of 10^{-4} to 10^{-6} automatically causes the VEMUR to be lifted and automatically qualifies the property for residential use without any other demonstration. Nevertheless, even ADEQ in the Interim Soil Remediation Standard Rule recognized that risk levels lower than 10^{-6} were appropriate for residential use based upon certain site-specific factors regardless of the category of the carcinogen.

Commenters provided language that they believe is consistent with ADEQ's previous interpretation of the definition of residential remediation level and is based upon the consideration of the same site-specific factors listed by EPA in the regulation incorporated by reference in the soil remediation statute. This language allows the use of site-specific factors to make the determination of the acceptable risk level within the range.

"Residential Site-Specific Remediation Level" means a level of contaminants in soil which will result in an excess lifetime cancer risk level between 1×10^{-4} and 1×10^{-6} and a Hazard Index no greater than 1 based on residential exposure assumptions. The selection of an excess lifetime cancer risk level within the range specified shall be based upon such site-specific factors as the presence of multiple contaminants, the existence of multiple pathways of exposure, the uncertainty of exposure and the particular sensitivity of the exposed population.

ANALYSIS: The Department agrees that A.R.S. § 49-152 does not prohibit the use of engineering controls to meet the site-specific remediation levels. Therefore, this prohibition will be removed from the rule. Persons remediating soil will be able to use engineering controls to meet the site-specific remediation levels if the risk assessment indicates that carcinogenic risk is equal to or less than the risk determined by site-specific factors using residential exposure assumptions (Please see Issue #10 for additional discussion regarding risk levels). However, it should be noted that the engineering controls must be approved by the Department and some legal mechanism must be in place to ensure that the controls will be maintained to prevent future exposure. The Department also agrees that notice should be provided if an engineering control is used to meet the standard, however, this is not required in statute. Therefore, the only notice that will be provided is in the Departmental Repository.

Finally, the Department agrees that the requirement to remediate to different site-specific levels based on the category of the carcinogen is inappropriate and is not required by statute. Therefore, the definition will be revised accordingly. In addition, R18-7-

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206 has been revised to include the factors that the Department will use to evaluate the appropriate risk level. Please see Issue #11 for more discussion on this topic.

RESPONSE: R18-7-201 is revised as follows:

"Residential Site-Specific Remediation Level" means a level of contaminants remaining in the soil after remediation which results in a cumulative excess lifetime cancer risk between 1×10^{-6} and 1×10^{-4} and a Hazard Index no greater than 1 based on residential exposure assumptions.

15. Residential Use; Guidance

ISSUE: In Section D: Summary of Differences Between Interim Rule and the Final Soil Remediation Standards Rule in the Preamble, the 2nd paragraph beneath the heading "Residential and Non-residential Standards," there is a paragraph indicating the Department is developing guidelines to assist owners in understanding which property uses should be considered residential. This is a fairly significant topic that has wide implications on owners in determining whether the residential or non-residential standards would apply to them. These guidelines should be incorporated in the definitions.

ANALYSIS: A.R.S. § 49-151(3) defines "residential use" as "...those uses of remediated property upon which there are dwellings where the residents are reasonably expected to be in frequent, repeated contact with soil, or other uses where natural persons are reasonably expected to be in similar contact, such as child care centers and elementary schools." This definition was discussed at length in several stakeholder meetings and it was determined that the statutory intent was a flexible definition that could take into account a variety of situations. It was agreed that the statutory definition is self-explanatory and could not be refined in this rule without compromising the intent. However, the Department intends to develop guidance on some common uses that may be presumed to meet the definition of residential use.

RESPONSE: No change to the rule.

16. Residential Use; Zoning

ISSUE: Based upon the definition of "residential use", all service stations or dry cleaners are not considered residential properties. However, most cities zone these services as Neighborhood Commercial (C-1), Central Business District (C-2) or General Commercial (C-3), or an equivalent designation. These are obviously not residential uses. However, the cities allow the construction or operation of pre-school or day care centers, nursing or convalescent homes, orphanages, etc. in all these zoning designations, without approval or special use permits. Therefore, there is the potential for a future use on 1 of these sites that could expose a sensitive receptor to contamination left in place at non-residential levels.

ANALYSIS: Even though the zoning requirements may allow different property uses, any person not remediating soil to the residential standards is required by A.R.S. 49-152 to record a VEMUR on the property and restrict the use of the property to non-residential use. The purpose of the VEMUR is to provide notice to potential buyers, lenders, and other interested parties of the restriction on the property's use. The Department is relying on this notice to prevent exposure to sensitive receptors on these properties.

RESPONSE: No change to the rule.

17. Soil

ISSUE: This definition appears to be too narrow. Semi-consolidated sediments or even consolidated materials can be contaminated and can impact surface receptors through volatilization or other pathways and can also result in the release of contaminants to groundwater. For example, caliche is a common form of soil that exists in a semi- or consolidated form. Also, weathered granitic or conglomeratic bedrock can and does exist in a semi-consolidated form. These materials would not require remediation with the current definition for soil.

The definition should address whether cleanups in areas of fluctuating groundwater levels would be required to address contaminated soils that are periodically unsaturated and then saturated as water levels fluctuate. In addition, consideration should be given to address contaminated soils in the saturated zone, which contribute to groundwater contamination, but are excluded from the rule by this definition.

ANALYSIS: The Department agrees that the proposed definition of soil was too narrow and should include consolidated materials also. Therefore, the definition has been revised to include essentially all materials within the vadose zone. Contaminated materials below the water table may contribute to groundwater contamination and should be addressed as part of a groundwater remediation.

RESPONSE: R18-7-201 is revised as follows:

"Soil" means all earthen materials located between the land surface and groundwater including sediments and unconsolidated accumulations produced by the physical and chemical disintegration of rocks.

18. VEMUR

ISSUE: In certain instances, such as condemnation actions or bankruptcy proceedings, the "owner" of the property no longer has possession or control of the property. It would be inappropriate for ADEQ to accept a VEMUR signed by the owner without the concurrence of the condemner, since the intent of a condemnation action often is to change the future use of the property. It

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also remains somewhat unclear how, and by whom, the restriction as to use of the property will be enforced (that is, if the property is used for residential purposes notwithstanding the filing of a VEMUR). In addition, there appears to be some words missing from the last 2 lines of the definition. It may read better if revised as follows ". . . that the owner agrees to restrict the use of the property to non-residential uses."

ANALYSIS: A.R.S. § 49-152(B) requires the owner to record a VEMUR if the property is remediated to non-residential uses. The Department's approval of the VEMUR is limited to verifying that the remediation achieved non-residential standards. The Department cannot force the real property owner to get concurrence from the condemner nor would the Department know to require such concurrence. By filing the VEMUR, the property owner agrees to restrict the property to non-residential use. The Department will use whatever enforcement authority is available to ensure compliance with appropriate cleanup standards.

RESPONSE: No change to the rule.

19. Volatile

ISSUE: The definition for volatile fails to recognize that the Henry's Law constant of a pure compound is a function of temperature and is specific to a particular solvent. The definition should state more specifically "the Henry's Law constant in water at 20°C." The definition completely ignores vapor pressure, the fundamental pure-species property. Alternately, boiling point could be used instead of vapor pressure. If vapor pressure were used, use of molecular weight and melting point in the definition would be unnecessary. A vapor pressure of 0.05 mm Hg (equivalent to naphthalene) could be used as a cut-off. The definition should be revised to something like:

32. "Volatile" means a chemical that has a Henry's Law constant greater than 10^{-5} atm-m³/mol at 20°C in water and, a molecular weight less than 200 g/mol, a melting point less than 25°C a vapor pressure of more than 0.05 mm Hg at 20°C.

The definition of the term, "volatile", should refer to a gram molecular weight less than 200 rather than, "a molecular weight less than 200 g/mol."

ANALYSIS: Volatile constituents have been identified in order to determine whether to evaluate inhalation exposure using a Volatilization Factor (VF) or the Particulate Emission Factor (PEF). Contaminants that meet the volatility criteria use the VF.

The EPA document entitled "Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals)" states that "...inhalation of volatile chemicals is relevant only for chemicals with a Henry's Law constant of 1×10^{-5} atm-m³/mole or greater and with a molecular weight of less than 200 g/mole." Because Henry's Law estimates the tendency for a chemical to volatilize from an aqueous phase and exist in the atmosphere or in soil air, these criteria are used to determine whether a chemical is considered volatile. The commenter correctly points out that the Henry's Law constant for a compound is dependent upon temperature.

In addition, models used to estimate flux in the exposure equations are based upon Henry's Law. Henry's Law takes into account solubility and vapor pressure, both of which determine how much chemical will be released from a soil matrix. Using vapor pressure alone would not be an appropriate way to determine volatility since it does not account for solubility.

However the term "volatile" is no longer used in the rule due to changes to depth limits for pre-determined standards. Please see Issue #15 in R18-7-204. The term has been deleted from the rule.

RESPONSE: R18-7-201 is revised to delete the term "volatile."

R18-7-202. APPLICABILITY

1. R18-7-202(A) General Applicability

ISSUE: The Proposed Rule states that the rule applies to "a person remediating soil subject to any of the following programs administered by the Department." The underlined language replaces the current phrase in the Interim Rule stating that the rule applies to a person "legally required to conduct soil remediation activities under any of the following regulatory programs administered by the Department." That language in the Interim Rule was negotiated with the Department to provide a clear delineation between volunteers and non-volunteers for purposes of the soil remediation program.

The reason for the proposed change reflected in the underlined text is not clear. However, the new language not only appears to broaden those soil remediations which are within the Department's programs, but creates uncertainty in the context of Department programs which are only remedial in nature (such as WQARF) and for voluntary actions. It could be interpreted as including consultants and contractors. The provisions should be clearly applicable only to persons subject to regulation under the listed programs, and avoid relating responsibility to actions taken on the soil. Consequently, the language from the Interim Rule should be retained.

ANALYSIS: The language was changed from the Interim Rule to reflect the Department's position at the time that it did not have authority for voluntary cleanups outside of the WQARF Voluntary Program. As such, the Department removed the provision that the rule applied to those who were not legally required to conduct remediation, but who requested a Close-Out Document. In order to allow the volunteers under WQARF to comply with the rule, the phrase "legally required to conduct" was replaced with "subject to." Since then, the Department has been granted the authority for voluntary cleanups (Please see Issue #2). As a result, the language will be modified accordingly.

RESPONSE: Please see Issue #2 for revisions to R18-7-202. Additionally, R18-7-201 is revised as follows:

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"Greenfields Pilot Program" means the system of requirements prescribed in Laws 1997, Ch. 296, § 11.

"Voluntary Remediation Program" means the system of requirements prescribed in A.R.S. § 49-104(A)(17).

"WQARF Voluntary Program" means the system of requirements prescribed in A.R.S. §§ 49-282.05 and 49-285(B).

2. Elimination of Voluntary Cleanups

ISSUE: The Department received numerous comments on the deletion of references to voluntary cleanups. In particular, R18-7-202(B) in the Interim Rule stated that the rule applied "to a person not legally required to conduct remediation, but who chooses to do so and who requests a close out document." Commenters were concerned that this deletion was inconsistent with the desires of the Soil Cleanup Standards/Policy Task Force to encourage voluntary remediations. It was pointed out that many sites exist where the party wishing to conduct the remediation is not legally responsible for the contamination. At other sites, a party may have caused contamination, but there may be no (or tenuous) cleanup obligations imposed under existing state law. A party in either situation that wishes to remediate contaminated soil not only should be allowed to do so, but should be encouraged to do so.

One of the chief benefits in establishing uniform cleanup standards, and particularly a voluntary program for achieving such standards, was the benefit of such an approach with respect to abandoned mines. Thousands of abandoned mines exist in the State of Arizona, and soil remediation may be appropriate at some of these sites. However, unless these sites are required to be addressed under WQARF (which is unlikely in the near future because of the need to focus resources on more extensive cleanup projects), there may not be a A.R.S. Title 49 program requiring cleanup of these sites. Creation of a streamlined voluntary cleanup program, with specific targets and processes and the opportunity to secure ADEQ approval after the cleanup is completed, accomplishes this desirable goal. Eliminating the voluntary cleanup provision will significantly reduce incentives for cleanup and result in many sites being cleaned up later (if at all), or cleaned up in a fashion later determined unacceptable to ADEQ. These rules clearly should be intended to apply to voluntary remedial activities.

ANALYSIS: The Department agrees with the commenters and recognizes the Task Force's intent to encourage voluntary remediations. At the time that the final rule was proposed, the agency had no statutory authority to regulate voluntary remediations outside those conducted pursuant to WQARF authority. For that reason, the references to voluntary actions were excluded from the rule language. However, several bills had been proposed in the legislature to give the Department authority to develop a voluntary program. The applicability section (R18-7-202(A)(7)) included "any other program under this Title that regulates soil remediation" in anticipation of this statutory authority. Since that time, legislation to establish a voluntary program and the Greenfields Pilot Program was passed. Therefore, the language will be reinserted.

RESPONSE: R18-7-202 is amended as follows:

A. This Article applies to a person legally required to conduct soil remediation by any of the following regulatory programs administered by the Department:

1. The Aquifer Protection Permit Program.
2. The Hazardous Waste Management Program.
3. The Solid Waste Management Program.
4. The Special Waste Management Program.
5. The Underground Storage Tank Program.
6. The Water Quality Assurance Revolving Fund.
7. Any other program under A.R.S. Title 49 that regulates soil remediation.

B. This Article also applies to a person who is not legally required to conduct soil remediation, but who chooses to do so under any of the following programs administered by the Department:

1. The Greenfields Pilot Program.
2. The Voluntary Remediation Program.
3. The WQARF Voluntary Program.

3. UST Volunteers

ISSUE: While the Preamble is clear as to the applicability of the proposed rule to persons conducting remediation under the WQARF Voluntary Remediation Program, the Preamble does not specifically address "volunteer" as defined in A.R.S. § 49-1016 for the purpose of conducting remediation under the Underground Storage Tank Program (UST). Is it a correct assumption that any such "volunteer" must comply with requirements of this rule, as is stated in the proposed rule itself in R18-7-202?

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ANALYSIS: Volunteers and UST owners/operators under the UST program must comply with the UST requirements including the Soil Remediation Standards in order to obtain case closure. A.R.S. § 49-1016(C)(4) provides that corrective action conducted by the volunteer must be in accordance with the UST corrective action statutes (A.R.S. § 49-1005). If the volunteer elects to discontinue the voluntary corrective action, the Department will look to the UST owner and operator to complete the remediation. The Soil Remediation Standards Rule will be used to determine if soil at the site has been remediated.

RESPONSE: No change to rule.

4. EPA Enforcement Actions

ISSUE: The Preamble states that the Soil Remediation Standards Rule would apply to persons subject to EPA enforcement actions. EPA will apply the soil remediation levels to EPA enforcement actions where EPA determines that they are applicable and appropriate. For example, EPA requires CIRCLE cleanups to meet applicable or relevant and appropriate state requirements (ARARs). By definition, state requirements are relevant and appropriate when they are more stringent than federal standards.

ANALYSIS: The Department agrees that EPA will apply the standards in this rule wherever applicable and appropriate. References to EPA enforcement actions have been deleted from the Preamble.

RESPONSE: No change to the rule.

5. Enforcement Process

ISSUE: Some discussion of the compliance enforcement process that the Department envisions will take place under the Soil Remediation Standards Rule would be helpful. ADEQ staff have stated that the proposed rule will be incorporated by reference into several regulatory programs, and that the compliance provisions of those programs would apply to actions governed by the rule. It is less clear whether those compliance provisions would apply to noncompliance with requirements unique to the rule, such as failure to file a VEMUR. In addition, what action would ADEQ take against a voluntary party conducting a remedial action if they are in not in compliance with the rule, other than to withhold a Letter of Completion?

ANALYSIS: As stated in the Preamble, this rule does not create new duties to remediate. Instead, the rule establishes Department-wide remediation standards and sets forth methods by which those remediation standards are calculated. Any non-compliance with the standards set out in this rule, including failure to file a VEMUR, will be handled by the individual program using whatever enforcement authority is available. For parties conducting remediations under the Voluntary Remediation Program (VRP), noncompliance with the rule provisions could mean termination of their eligibility to participate in the VRP. For those parties who have opted for the voluntary track, but who would be required to conduct soil remediation under other A.R.S. Title 49 program authority, noncompliance could result in referral to the relevant program and possible enforcement action.

RESPONSE: No change to the rule.

6. Program Procedural Requirements

ISSUE: If achieving the soil cleanup levels satisfies the substantive remediation requirements of all of the listed programs, but not necessarily the procedural requirements of those programs, the language of the rule should reflect that view. The provision should be changed as follows:

- B. Nothing in this article is to be interpreted as waiving the procedural requirements applicable to remediation under the programs described in Subsection A.

If the listed programs have soil remediation provisions that may in any way conflict with the provisions of the new rule, the following language should be used:

- B. All specific requirements of the programs described in subsection (A) shall continue to apply to persons remediating soil pursuant to any such program, except those specific requirements that conflict with the provisions of this Article.

ANALYSIS: The remediation standards in this rule replace any soil remediation levels previously used by individual programs. Compliance with the Soil Remediation Standards Rule only means that the cleanup standards have been met. Compliance with this rule does not necessarily satisfy any substantive or any procedural requirements of the listed programs. This rule establishes Department-wide remediation standards and sets forth methods by which those remediation standards are calculated. It is not a stand alone program for remediation. The purpose of R18-7-202(C) is to make it clear that the listed programs may have requirements that this rule does not address. For example, clean closure under the Resource Conservation and Recovery Act (RCRA) requires regulated persons to clean up saturated soils and associated groundwater. The RCRA clean closure groundwater cleanup requirements would continue to apply to the regulated community after satisfying the Soil Remediation Standards Rule.

RESPONSE: No change to the rule.

7. Program Procedural Requirements for Volunteers

ISSUE: There is little benefit in requiring all persons willing to remediate a site to follow every programmatic element in the same manner as if he or she were subject to an enforcement order when nobody is forcing them to perform these activities (even if not technically a "volunteer"). This is particularly true if the remediation level to be utilized is the residential SRL. With mea-

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asures requiring the prioritization of sites under WQARF reform, there will be an increasing need for persons to "voluntarily" remediate non-priority sites. Everything possible should be done to encourage these voluntary remediations even where a person or non-priority site is technically subject to ADEQ's jurisdiction.

ANALYSIS: The Department agrees that not all program procedural requirements should necessarily be required for voluntary remediations. SB 1452 enacted in the last legislative session allows parties remediating under the VRP to petition the Department to exempt procedural program requirements. The VRP will work with the programs to evaluate any petitions and grant the exemptions. Also, see Issue #2 pertaining to the voluntary program.

RESPONSE: No change to the rule.

8. Biosolids Applications; Extension for Public Comment

ISSUE: Several commenters indicated that they did not have the opportunity to review the proposed Soil Remediation Standards Rule in enough detail to provide adequate comments. They requested an extension of the comment period to further study the effect of this rule on the land application of biosolids and normal agricultural activities.

ANALYSIS: The requested extension was granted. The public comment period was extended from April 4, 1997, to May 9, 1997, to accommodate this request. In addition, the Department conducted a meeting with those parties dealing with biosolids applications to discuss potential impacts to the Biosolids Program and determine if any conflicts existed.

RESPONSE: No change to the rule.

9. Biosolids Applications; Impacts

ISSUE: Many comments were received on the potential impacts the Soil Remediation Standards Rule could have on the beneficial reuse of biosolids in Arizona for the conditioning of soil or the fertilization of crops. The Land Application of Biosolids Rule (A.A.C. R18-13-1501 et seq.) adopted by ADEQ in 1996 addresses the land application of wastewater treatment plant sludges (a.k.a. biosolids). The rule is based on federal sludge rules (40 CFR 503) which were finalized on February 19, 1993. Among other things, these rules establish maximum concentrations of certain contaminants that can be applied to agricultural land at any time and establishes limits of certain contaminants that can be applied over time.

Several commenters indicated that cleanup levels for some contaminants listed in Appendix A of the proposed Soil Remediation Standards Rule would discourage biosolids application programs. For example, the proposed residential and non-residential SRLs for arsenic are 0.38 mg/kg and 2.4 mg/kg, respectively. The monthly average concentration of arsenic in sludge considered to be "excellent quality" (EQ) is 41 mg/kg (see A.A.C. R18-13-1505, Table 2). The ceiling (maximum) concentration of arsenic in sludge for application to agricultural land is 75 mg/kg (see A.A.C. R18-13-1505, Table 3). While these values are for the concentration of the metal in the sludge, and the SRLs are the maximum allowable concentration in the soil, the magnitude of difference between the values in the biosolids rules and the proposed soil remediation rules creates a real concern for some that arsenic in agricultural soils receiving even EQ sludge could quickly reach levels that exceed the SRLs. They believe that once the proposed SRLs are exceeded, the soil remediation standards would require property owners who applied biosolids on agricultural land to remediate the property.

In particular, commenters requested clarification of the potential use of the SRLs as action levels in assessing the potential for release of hazardous substances which may result in listing a site on the Federal Superfund's National Priority List. They indicated that the soil remediation standards are ARARs under CERCLA which are action levels for a determination whether or not sites should be cleaned up.

In addition, 1 commenter indicated that the section on applicability, R18-7-202, cites several regulatory programs which may precipitate a remedial action: A.R.S. § 49-701.01(A) defines "sludge from a waste treatment plant" as "solid waste"; A.R.S. § 49-921.5 includes "sludge from a waste treatment plant" in the definition of "hazardous waste"; and it appears that remediation could be required under WQARF. Without a specific exemption in the rule, there is no legal assurance that remediation will not be required for biosolid applications. Therefore, R18-7-202(E) should be revised as follows:

This article does not apply to contaminant concentrations that have resulted from the application of irrigation water, fertilizers, or sludge from a publicly owned treatment works that is subject to 40 CFR 503 or A.A.C. R18-13-1500.

Other commenters indicated that even if there is no legal requirement to remediate, the different limits between the biosolids rule and this rule can give rise to unnecessary concern regarding when a soil is determined to have "hazardous" levels of metals. Several stated that there is an unwritten perception that any level above the SRL is a health concern, or a reason to begin soil remediation. The existence of these standards is especially problematic on sites where biosolids are applied since biosolids applicators are required by the ADEQ to track arsenic levels. The general public will perceive soil is contaminated if it exceeds SRLs. This would create a stigma that land that receives biosolids applications is "contaminated" and unsafe for residential use. This could impact the marketability of the land for future uses. For example, if a farmer plans to sell his land, a prospective purchaser or developer may require the soils to be remediated to the appropriate SRL. In addition, no banker will lend money on property that has been impaired if the purpose of that lending is for developing a subdivision or residential property. Furthermore, there is also a potential that a landowner may be required to initiate a remedial action for a spill of material unrelated to land application; in which case the entire property including the land used in sludge application may come under departmental scrutiny, becoming subject to these remediation standards.

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These commenters requested that ADEQ review the impact of this regulation by having land appraisers evaluate the economic impact on the appraised value of this land due to the stigma of being in excess of the new regulatory standard. They also stated that ADEQ should insert language into the proposed rule to eliminate the potential for the SRLs to be interpreted such that "any limit above the SRLs deems the property as hazardous and remediation is required."

Numerous commenters indicated that any of the risks to the farmer discussed above could result in the discontinued or reduced use of biosolids applications. They stated that this would negate not only the benefits to the farmers due to the fertilizing and soil conditioning properties of the biosolids, but also to the biosolids generators who avoid the expense of disposing of biosolids in landfills. These commenters concluded that ADEQ should seek to avoid a residual effect of the rule that could compromise a beneficial program. They also said that it would be unfair and a great economic burden to promulgate these standards and have them apply to agricultural land that has had biosolids applied.

Furthermore, a generator of biosolids (a wastewater treatment facility) was concerned that it may be held liable for future potential damage to the value of property that received applications of biosolids from its facility. It stated that there is a potential for tort action in the amount of millions of dollars. It concluded that ADEQ should clearly establish that legally applied fertilizers, pesticides and sludge are not actions that legally create liability in any fashion for diminishment of value of the land or responsibility for remediation of the land.

ANALYSIS: The Department would like to clarify that the proposed Soil Remediation Standards Rule establishes cleanup standards for soil remediations that are required to be performed under A.R.S. Title 49 authority. Those standards also apply to parties who are not legally required to remediate, but who wish to do so to obtain a letter from the Department stating that the property in question meets the soil remediation standards. The rule does not create an obligation to conduct remediation. Soil containing concentrations of contaminants greater than those listed in Appendix A does not, of itself, require remediation.

In contrast, the biosolids rule establishes limits on the concentrations of several pollutants in sewage sludge (biosolids) used to condition soil or fertilize crops and establishes limits on the loading of several pollutants to the land. The application of biosolids to agricultural lands would not be considered a release of a hazardous substance under a A.R.S. Title 49 program and would not trigger a requirement to conduct soil remediation. Therefore, an agricultural exemption from the Soil Remediation Standards for the land application of biosolids is not appropriate or needed.

In regard to the SRLs as ARARs under CERCLA or as action levels for other programs, soil contamination that exceeds the SRL may be used as confirmation that a release of a hazardous substance has occurred. Further investigation may be required under any program, including federal Superfund. Investigation does not mean that the site in question must be remediated.

The definitions of solid waste and hazardous waste which include sludge from a wastewater treatment plant are intended to apply to sludge which is mismanaged, not sludge that is legally applied to the land as prescribed in the biosolids rule. As stated previously, this rule does not create any new obligations to remediate. If any conflict exists, it exists with or without this proposed rule because all of the programs listed in the R18-7-202(A) have independent authority to require remediation. The soil remediation standards only indicate the level to which soil must be remediated in order to satisfy a regulatory program that requires remediation.

In response to the comments that any property which exceeds the SRLs will be considered "dirty", SRLs are concentrations of contaminants that do not represent a health risk based on the exposure assumptions used in the calculations. Concentrations greater than the SRL may not represent a health risk and should not be interpreted to represent "hazardous" levels. However, the Department was very concerned that the biosolids program may be jeopardized if a perception exists that any property which exceeds the SRLs may be unsafe for development. As a result of statements that farmers may be reluctant to apply biosolids to their lands due to concerns about future marketability of their land for development, the Department evaluated the impacts of this rule on the Biosolids rule and considered other options.

A review of the biosolids rule indicates that only 1 contaminant, arsenic, may be higher than the proposed SRLs. The proposed residential and non-residential SRLs were 0.38 mg/kg and 2.4 mg/kg respectively. The ceiling pollutant concentrations and monthly average concentration of arsenic in sludge are 75 mg/kg and 41 mg/kg respectively (A.A.C. R18-13-1505). However, these concentrations represent the amount that can be present in the sludge, not the concentrations that are allowed in the soil. On the other hand, the cumulative pollutant loading rate for arsenic in sludge is 41.0 kg/hectare. In order to determine the concentration in soil, the units must be translated to mg/kg by making some assumptions about the depth of the application (6 inches) and the weight of a hectare of soil (2.2 million kilograms). This equates to a maximum allowable lifetime concentration in soil of 18.6 mg/kg.

The Department evaluated the potential for land application of biosolids to result in arsenic concentrations that could exceed the residential SRL. Generally, concentrations of arsenic in biosolids reported to the Department are low, rarely exceeding 10 mg/kg. Once again, this represents arsenic in the sludge and does not account for mixing with the soil or other factors such as plant uptake. Little data is available on soil concentrations of arsenic resulting from biosolids applications. The information supplied to the Department as required by the Biosolids Rule represents the concentrations applied to the land and does not provide actual soil concentrations.

The Department reviewed a report prepared by the University of Arizona documenting the results of a 10-year evaluation of the land application of biosolids generated by Pima County Wastewater Management. Three soil plots were tested: a control plot that received no biosolids, a plot that received a yearly application, and a plot that received 3 applications in a year. After 10

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years of application, soil concentrations of arsenic in all plots did not exceed the laboratory method detection limit of 5 mg/kg (I.L. Pepper, et al., 1996).

The Department received numerous comments on the proposed SRL for arsenic in addition to the comments on the biosolid levels (Please see comments on Issue #17 in R18-7-204). There were many comments that the arsenic SRLs were not reasonable standards because naturally occurring background concentrations of arsenic in Arizona soils were higher than the proposed standards. In response to comments received, the Department adopted standards that represent average background levels for arsenic in Arizona soils: 10 mg/kg for residential and non-residential SRLs. Land application of biosolids to agricultural lands most likely will not exceed the residential standard. However, if a farmer intends to change the future use of land to a residential use, there is the potential to exceed the residential SRL if biosolids are applied for the maximum period of time, at the maximum annual concentration, and to the minimum depth of 6 inches. The Department feels it is unlikely that all these conditions will exist at any 1 location. Therefore, the Department feels that the adopted arsenic SRL should not have an adverse impact on the biosolids program. The Department supports the biosolids program as a beneficial end use of wastewater treatment sludge. Based on existing data, the adopted arsenic SRLs are believed to be technically defensible and are set at levels that should not pose a threat to land application of biosolids.

In regard to the comments on limiting liability for diminishment of the value of the land where biosolids are applied, the Department can only limit those legal responsibilities within its statutory authority such as remediation requirements under A.R.S. Title 49 programs. This rule cannot control 3rd party concerns about the potential for adverse impacts to the future value of agricultural land caused by the legal applications of biosolids.

RESPONSE: The arsenic SRLs have been modified. (Please see Issue #17 in R18-7-204)

10. Biosolids Methodology

ISSUE: The Department received several comments on the different methods to establish the SRLs and the biosolid limits. Several commenters expressed concern that ADEQ's approach to establishing SRLs was inconsistent with EPA methodology and had received little or no technical evaluation. They believed EPA's approach for the Biosolids Rule was better because of the length of time for development, the level of expert involvement and peer review, and because the rule had survived several legal challenges. Also, they commented that EPA had performed a more comprehensive evaluation of risk.

In developing pollutant loading levels for the biosolids rule, EPA modeled 14 exposure pathways that could result from land application of biosolids. For any particular pollutant, the number of pathways evaluated depended on available information and whether a particular pathway was appropriate for that pollutant. The pollutant limit included in the 503 rule is the most stringent value from the risk assessment. Therefore, the limit should be protective of all pathways evaluated for the 10 pollutants modeled. For arsenic, the exposure pathway was a Highly Exposed Individual (a child between 1 and 6 years of age) who ingests undiluted biosolids daily for 5 years. EPA determined that 41 mg/kg of arsenic in biosolids posed no threat to the child through this exposure pathway. Another commenter questioned how the Department arrived at the 1×10^{-6} risk level instead of the 1×10^{-4} risk level utilized by the U.S. EPA in their development of the biosolids levels. Finally, 1 commenter stated that the Department determined that EPA standards were so acceptable that they promulgated them as the State of Arizona Sludge Applications Standards. With the promulgation of these soil standards, the Department has promulgated 2 sets of standards for safe soil.

ANALYSIS: ADEQ's methodology for developing the SRLs uses the most recent updates to EPA equations for evaluating risk through ingestion, inhalation and dermal contact exposures. The proposed arsenic SRLs were based on these calculations at a 10^{-6} risk level. According to an EPA report entitled, "The Part 503 Land Application Pollutant Limits For Arsenic," (Southworth, 1995), EPA selected a 1×10^{-4} risk level for carcinogens when developing the 503 rule. Although EPA classifies arsenic as a known human carcinogen, EPA did not evaluate cancer risk from direct ingestion of arsenic in sewage sludge in setting the 503 standards. Several assumptions were cited as justification for this approach. EPA concluded that most arsenic in biosolids was organic arsenic. The IRIS cancer potency value for arsenic is based on inorganic arsenic. Also, it was expected that organic arsenic in the sludge was not bioavailable. From these assumptions, EPA concluded that arsenic could be evaluated as a non-carcinogen. In evaluating the toxicity of arsenic in sludge, EPA used a different reference dose (RfD) than the 1 listed in the IRIS database and cited a number of reasons specific to biosolids and potential application scenarios to support that decision (Southworth, 1995).

The SRLs must apply to a broad range of possible site conditions, therefore, many of the assumptions for biosolids do not apply. Additionally, the SRLs are developed for 3 exposure pathways rather than just the ingestion pathway evaluated by EPA for the Biosolids Rule. Nevertheless, because the Department received numerous comments on the relationship of the arsenic SRL and the Biosolids Rule, (Please see previous issue), the arsenic SRLs have been modified to represent the average background level for arsenic in Arizona soils: 10 mg/kg for both residential and non-residential. (Please see Issue #17 in R18-7-204).

In regard to the differences between the risk management levels of the Soil Remediation Standards and the Biosolids Rule, extensive discussions were held in the Task Force on the issue of the proper risk management level for the final pre-determined standards. No consensus could be reached and the decision was deferred to the Director. The Director considered various recommendations made by Task Force members and received input from members of the health care field and experts in related fields. Based on this input, the Director decided that the final SRLs should be calculated with a 1×10^{-6} excess lifetime cancer risk level for Class A (known human) carcinogens and 1×10^{-5} risk level for B1 and B2 classes of carcinogens. The Director's decision is a policy decision and similar to EPA's decision to adopt the 1×10^{-4} approach in assessing the carcinogenic risk

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associated with biosolids. Both risk levels are within the range of risks that EPA has determined to be acceptable (Please see Issue #6 in R18-7-204).

RESPONSE: No change to the rule.

11. Effective Date; Definitions

ISSUE: The Department received numerous comments on the terms used in R18-7-202(D) to determine when a soil remediation is considered "initiated." It was pointed out that lack of specifics may lead to uncertainty on the part of the regulated community and the Department in determining compliance. One commenter stated that in order to minimize debate over what is meant by "the lateral and vertical extent of contamination," ADEQ should insert the phrase "in a manner consistent with current program requirements" after the word "characterized." Another commenter suggested the following language to specify when a site would be characterized:

A soil remediation is considered initiated when the person conducting the remediation has characterized the lateral and vertical extent of contamination at concentrations that exceed an agreed upon site-specific remediation level or, if such level has not been established, a level mutually agreed upon by the person conducting the remediation and the department and has prepared a work plan identifying the intended remedial measures.

Several others provided comments on the fact that "work plan" is not defined and ADEQ approval is not required. They stated that common understanding of the term "work plan" could include the requirements for an "Initial Notice" as established under R18-7-207(B). If Notice of Intent is intended to be the trigger, the rule should state as such. However, Department approval would not be a requirement in that case. As currently written, preparation of a work plan could, literally, be accomplished mentally with nothing reduced to writing. By requiring the work plan to be submitted to the Department and defining certain minimum standards for a work plan, a specific date is established for administrative purposes and the requirement for subsequent approval would establish that the work plan did meet the requirements of this rule and of the program. The added clarification will establish a "bright line" for purposes of determining the rule provisions (interim or final) under which the remediation will be conducted. Additionally, if not required in rule, the CES or the preamble should establish that "work plans" include those submitted in accordance with A.A.C. R18-12607.01 and corrective action plans in accordance with 40 CFR 280.66 and any other authorities whereby the Department reviews and approves of plans for remediation.

The matter of whether full characterization has been achieved is rendered moot by establishing acceptance of the work plan as the bright line. Given that there is no detailed criteria on extent in rule, it appears best not to make this a transition issue. Examples of the problems that arise include: Does the lateral and vertical extent include cobble zones, fractured materials, aquifers, or just to soils that can be sampled? How will off-site access problems be addressed? Is extent just that needed for soil cleanup or does it include determination as to whether groundwater has been contaminated?

Lastly, commenters indicated that the 2nd sentence of this section that addresses when a remediation is initiated might be better handled as a definition of "initiate." The fact that this sentence defines "initiate" indicates that it should be placed in R18-7-201. In addition, R18-7-202(D) should read "This Article does not apply to soil remediation projects that...."

ANALYSIS: The Department added the provision that a site had to be fully characterized and a work plan prepared in order to clarify the meaning of "initiated." If a person had completely characterized the site, the Department felt that it was inappropriate to require additional characterization to a new standard. It is not the Department's intention to define the terms "extent of contamination" or "work plan" in this rule. The programs administering the soil remediation will make this determination. Instead, the purpose of this rule is to establish cleanup standards applicable to the programs. However, the Department acknowledges that the proposed language was not clear as to which rule, the Interim Rule or the Final Rule, would apply.

The Department disagrees that a Department-approved work plan should be used as the "bright line" for applicability. It has always been the Department's intention to allow some remediations to be conducted without prior Departmental approval. Work plans are not necessarily required by all programs and those conducting remediations voluntarily are not required to submit work plans.

The Department believes that the determination of whether the Interim or the Final Soil Remediation Standards Rule applies should be based on whether the site has been adequately characterized. "Characterized" will be defined to mean that laboratory analytical results have been received by the person conducting the remediation delineating the full extent of soil contamination. This means that although the remediating party is not necessarily required to obtain the Department's concurrence whether the site has been characterized, they should be confident that it has been. This is especially true if the remediating party will be requesting a Letter of Completion from the Department. It should be noted that the Department strongly recommends obtaining concurrence on characterization from the Department in order to minimize the potential to conduct additional sampling at a later time.

In addition to establishing a clear cut-off date for applicability of the Final Rule, the Department also believes that remediating parties should be given the choice to remediate under the Final Rule if the new standards under the Final Rule are less stringent than the standards under the Interim Rule. However, if the new standards are more stringent, the remediating party must determine which rule applies and remediate to the appropriate standard.

RESPONSE: R18-7-202 is revised as follows:

- E. A person who is remediating soil at a site which is characterized before the effective date of this Article shall comply with either the Soil Remediation Standards adopted as an interim rule on March 29, 1996, or the Soil Remediation Standards

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adopted in this Article. A site is considered characterized when the laboratory analytical results of the soil samples delineating the nature, degree, and extent of soil contamination have been received by the person conducting the remediation.

12. Effective Date; Transition

ISSUE: The Final Soil Remediation Standards Rule does not provide language sufficient enough to transition from the Interim Soil Remediation Standards Rule. The following are questions which should be addressed in the final rule: 1) How are sites which are in line for closure review at present going to be handled upon the implementation of the new rule? 2) When the Soil Remediation Rule is implemented, will the new SRLs be the only remediation levels accepted or will a choice of remediation levels be given? Since most programs affected by this rule have a backlog of sites in which closure has been requested, it seems that this issue needs to be specifically addressed in the final rule. 3) Will sites which are currently being characterized laterally to the Interim Soil Remediation Standards (some of the borings have been completed) require further characterization if the SRLs are more stringent? If so, will all of the characterization cost be eligible for reimbursement through the UST SAF? 4) How will the new remediation levels affect SAF Preapproval Applications which have been approved based on the Interim Soil Remediation Standards? 5) Can the site be cleaned up to either standard and still get reimbursed?

ANALYSIS: As stated in the analysis of Issue #11, the determination of which rule applies is tied to the characterization of soil contamination at the site. Reports that have been submitted to the Department for closure review will be reviewed based on the date of characterization, as defined in the rule. Even if a site has been characterized prior to the effective date of the Final Soil Remediation Standards Rule, the Final Soil Remediation Standards Rule may be used if they are less stringent than the Interim Soil Remediation Standards Rule. Persons currently characterizing a site will have to determine if they have received the analytical results from the laboratory before the effective date of the Final Rule in order to ascertain if they will be required to remediate to any standards in the Final Rule that are more stringent. Under the provisions of SB 1331 passed during the 1997 Legislative Session, a UST owner or operator may elect to remediate to the more stringent SRL and be eligible (subject to all the SAF requirements), provided a closure letter for the site has not been received.

RESPONSE: Please see previous Issue #11 for revisions to R18-7-202(E).

13. Effective Date; Total Petroleum Hydrocarbons

ISSUE: Because the Rule proposes a change in the laboratory reporting of hydrocarbons for purposes of the new hydrocarbon SRL, there may be a problem if site characterization data obtained under current practices are to be used for a remediation project subject to the Rule. Current practice is to quantify total petroleum hydrocarbons (TPH), not just the C₉+ range applicable to the proposed SRL. ADEQ should authorize the use of TPH data based on current laboratory methods for remediation under the Rule, if those data were acquired prior to the effective date of the Rule.

ANALYSIS: The remediating party must determine which rule, the Interim Rule or the Final Rule, applies to their site using the criteria listed in R18-7-202(E). Once this is known, the analytical methods appropriate for that rule should be used. For example, TPH should be analyzed if the Interim Rule applies. Please see Issue #20 in R18-7-204 for additional discussion on the hydrocarbon SRL.

RESPONSE: No change to the rule.

14. Applicability to Orders

ISSUE: Although it is not found in the Interim Soil Remediation Standards Rule, the Department adopted a policy that excluded administrative and judicial orders from the Interim Soil Rule requirements. A new subsection should be established that clarifies the matter:

E. This Article does not apply to soil remediations that are subject to:

1. An Order of a court of competent jurisdiction.
2. An Order of the Director.

ANALYSIS: Persons subject to orders are legally required to comply with the terms of the order. The only relation an order might have to this rule is if the order references the soil cleanup levels or states a cleanup level for remediation. It should be noted that parties to orders may seek amendment of the orders as allowed by the order or other legal procedure. The Department would be receptive to requests for amendment where cleanup standards for a contaminant have become less stringent.

RESPONSE: R18-7-202 has been amended as follows:

G. This Article does not apply to persons remediating soil to numeric soil remediation levels specified in orders of the Director or orders of any Court that have been entered before the effective date of this Article.

R18-7-203. REMEDIATION STANDARDS

1. Criteria for Developing Site-Specific Remediation Standards

ISSUE: ADEQ should incorporate into this section of the rule the following 3 criteria paraphrased from the ASTM "Standard Guide for Risk-Based Corrective Action at Petroleum Release Sites," which are offered as possible additional considerations in determining whether further work to establish site-specific cleanup standards is warranted for a given site:

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1. Do site conditions differ significantly from the conservative "generic" parameters used to establish SRLs? If not, then recalculation of site-specific cleanup standards will probably not result in significantly different cleanup goals, and SRLs should be used.
2. Does preliminary analysis indicate that site-specific cleanup standards will differ significantly from SRLs? If not, then the extra site work required to establish site-specific levels is not warranted, and SRLs should be used.
3. Does the cost of obtaining site-specific data and calculating site-specific cleanup standards exceed the cost of cleanup to SRLs? If so, then it is not cost effective, and SRLs should be used.

These are important considerations for selection of cleanup standards and may also help prevent the potential abuse of the system through performance of potentially unnecessary site-specific data collection and risk assessment work in cases where SRLs or background concentrations are more appropriate.

ANALYSIS: Although the 3 criteria may be useful in determining whether or not to select the site-specific approach, the statute and rule allow the party conducting the remediation to make that decision. Consideration of these criteria is recommended, not required, when deciding whether to select the SRLs or a site-specific risk assessment approach and will be included in the guidance for risk assessments.

RESPONSE: No change to the rule.

2. General Requirements

ISSUE: The provisions of this subsection largely duplicate the provisions set forth in R18-7-204(A) and R18-7-205(A). The language at R18-7-205(A) is superior to that at R18-7-203(A), and the latter should be eliminated.

ANALYSIS: R18-7-203(A) provided the requirement to remediate to the pre-determined standards or the site-specific levels as mandated by A.R.S. § 49-152(A). R18-7-204(A) and R18-7-205(A) provided additional information required to remediate to the respective standard. However, the Department acknowledges a lack of clarity in the proposed rule text, especially regarding the site-specific remediation levels. Because the background standard must be established on a site-specific basis, the proposed rule included the background remediation standard in R18-7-205, Site-Specific Remediation Standards. Due to the confusion generated by this designation, the Final Rule returns to the approach in the Interim Rule and includes background remediation standards in a separate section of the rule, R18-7-204.

RESPONSE: R18-7-203 is revised as follows:

- A. A person subject to this Article shall remediate soil so that any concentration of contaminants remaining in the soil after remediation is less than or equal to 1 of the following:
 1. The background remediation standards prescribed in R18-7-204.
 2. The pre-determined remediation standards prescribed in R18-7-205.
 3. The site-specific remediation standards prescribed in R18-7-206.

3. Conditions; Alternative remediation Levels

ISSUE: The additional remediation standards identified at R18-7-203(B)(2)-(4) should include provisions for developing an alternative soil remediation level similar to the provisions found at R18-7-203(B)(1) and (B)(5). The following revision is suggested:

- A. In addition to satisfying the remediation standards set forth in Sections R18-7-204(A) and R18-7-205(A)(2), any concentration of contaminants remaining in the soil upon completion of the remediation shall not:
 1. Cause or threaten to cause contamination of groundwater in excess of any numeric Aquifer Water Quality Standard at a program-specific point of compliance pursuant to R18-11-406, or if there is no numeric Aquifer Water Quality Standard, in excess of the narrative Aquifer Water Quality Standards pursuant to R18-11-405 at a program-specific point of compliance. If the remediation level for a contaminant in the soil is not protective of groundwater quality, a person shall remediate to an alternative soil remediation level that is protective of groundwater quality. A scientifically valid demonstration shall be made to The determination of an alternative soil remediation level and shall include an analysis of site-specific and contaminant-specific characteristics.
 2. Cause or threaten to cause a violation of the Water Quality Standards pursuant to Title 18, Chapter 11, Article 1. If the remediation level for a contaminant in the soil is not protective of surface water quality, a person shall remediate to an alternative soil remediation level that is protective of surface water quality.
 3. Exhibit the hazardous waste characteristic of ignitability, corrosivity or reactivity as defined in R18-8-261(A). If the remediation level for a contaminant in the soil results in leaving soils exhibiting a hazardous waste characteristic other than toxicity, a person shall remediate to an alternative soil remediation level below that at which the remaining soil exhibits such hazardous waste characteristic.
 4. Cause a nuisance. If the remediation level for a contaminant in the soil results in a nuisance, a person shall remediate to an alternative soil remediation level that will not cause a nuisance.

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5. Cause or threaten to cause an adverse impact to ecological receptors. If the remediation level for the contaminant is not protective of ecological receptors, a person shall remediate to an alternative standard based on an ecological risk assessment. The following factors shall be used in evaluating impacts to ecological receptors
 - a. The contaminant's ability to bioaccumulate.
 - b. Demonstration of complete exposure pathways.
- B. All demonstrations required pursuant to this Section shall have a scientifically valid basis.

ANALYSIS: The Department agrees that alternative soil remediation levels should be an option for each condition listed. The language for each condition will be revised. However, several of the conditions have been modified in response to comments. Please see: Issue #10 for rule text changes for both the groundwater and surface water conditions; Issue #11 in R18-7-201 for changes to the nuisance condition; and Issue #12 for changes to the ecological receptor condition.

RESPONSE: Please see Issue #10 for changes to the rule text.

3. Groundwater Condition; Scientifically Valid Demonstration

ISSUE: What criteria will ADEQ apply to determine whether methods used to determine potential impacts to groundwater quality are acceptable and "scientifically valid"? Scientists have been known to disagree; 1 of the purposes of rulemaking is to limit the areas of disagreement.

ANALYSIS: A guidance document has been developed which presents a methodology for determining the potential for adverse impacts to groundwater quality. The document "A Screening Method to Determine Soil Concentrations Protective of Groundwater Quality" was developed by a working group of the Soil Cleanup Standards/Policy Task Force made up of representatives from environmental consulting firms, businesses, utilities and ADEQ. The guidance does not prescribe a strict methodology but offers a framework for a tiered approach to evaluate protection of groundwater quality. Following the procedures outlined in the guidance is presumed to be a scientifically valid demonstration. Alternative approaches also may be determined to be acceptable to the Department, therefore, no reference to the guidance document is placed into the rule text.

RESPONSE: Please see Issue #10 for changes to the rule text.

4. Groundwater Condition; Exceeding Aquifer Water Quality Standards

ISSUE: WQARF and UST programs have been amended to allow the Director to approve remedial actions that may result in water quality that does not meet aquifer water quality standards (AWQS) at the completion of the remedy. Commenters requested that the language requiring protection of groundwater be amended to conform with the new statutory language.

ANALYSIS: The Director's discretion under WQARF is limited to approving groundwater remedies that may result in groundwater quality exceeding AWQS. This determination can be made if the requirements related to WQARF remedies are met. A similar provision was added for UST corrective actions, but the Director must adopt rules to implement that provision. The Department has determined that the Director's discretion is related to groundwater, not soil, and does not diminish the requirement to cleanup soil to protect groundwater quality to the AWQS.

A key concept in developing the soil remediation standards was that soil cleanup requirements would not be loosened because underlying groundwater does not now or might not in the future meet AWQSs. This was to prevent the land area located over poor quality groundwater from becoming a "sacrificial zone" due to insufficient soil cleanups. Loosened soil remediation standards might also encourage existing operations to relax their waste management practices, contributing even further to the problem. If new approaches are developed in the future to restore groundwater to AWQSs, the legacy of loosened soil remediation standards, and the continuing sources they caused, could jeopardize such a future groundwater restoration initiative.

RESPONSE: No change to the rule.

5. Groundwater Condition; Numeric Aquifer Water Quality Standards

ISSUE: Several commenters indicated that the leachability screening requirement should not apply to contaminants without established numeric AWQS. This rulemaking is guided by A.R.S. § 49-152(A) which mandates the director to establish cleanup standards. Nothing in that statute authorizes this provision in the proposed rule. In any event, the rule is duplicative of other legal requirements under other programs, such as narrative aquifer quality standards under A.R.S. § 49-223.

Others indicated that mandating that residual soil levels not cause an exceedance of a narrative AWQS is an ambiguous requirement and requires the establishment of a numeric water quality standard for the substance at the applicable point of compliance in order to be able to calculate the appropriate groundwater protection level (GPL). Enforceable numeric AWQS can only be created through rulemaking. Consequently, this screening requirement is an improper attempt to avoid the statutory requirement for rulemaking.

In contrast, some commenters stated that the requirement that remaining concentrations in soil shall not cause or threaten to cause contamination of groundwater in excess of any numeric R18-11-406 or narrative R18-11-405 AWQS may not be fully protective of groundwater in cases where no AWQS exists for a given compound. For example, methyl tertbutyl ether (MTBE) in soil may dissolve readily into water passing through the contaminated soil profile and enter the groundwater. Due to the lack of an established AWQS for MTBE, ADEQ would be unable to require soil cleanup to levels protective of groundwater quality.

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ANALYSIS: A.R.S. § 49-152 requires that soil cleanup standards should "protect public health and the environment." The provisions of R18-7-203 refer to other authority of the agency that affect soil remediation. In this case, the other authority is found in A.R.S. § 49-221. The requirement to be protective of groundwater quality includes both numeric and narrative standards.

The Department added the condition to protect groundwater so persons remediating soil would be assured that another program would not require further soil remediation to protect groundwater. It is not the intention of the Department to establish numeric AWQS through this rule or specify how narrative AWQS should be determined. The reference to numeric and narrative AWQS has been deleted from the rule. However, removing the reference to the narrative standards does not relieve the remediating party from the requirement to remediate soil to a level that it is protective of groundwater to the narrative and numeric standards.

RESPONSE: Please see Issue #10 for the revision to R18-7-203(B)(1).

6. Groundwater Condition; TPH

ISSUE: What is an acceptable method to determine a site-specific concentration of TPH in soil in order to prevent the future occurrence of free product or nuisance aesthetic impacts to groundwater?

ANALYSIS: TPH is no longer evaluated as a contaminant under the Final Soil Remediation Standards Rule (Please see Issue #20 in R18-7-204). The hydrocarbon C₁₀ - C₃₂ standard now deals only with chemicals which are not likely to leach to groundwater. In addition, the standard represents levels that are lower than concentrations that would indicate free product.

In regard to nuisance aesthetic impacts to groundwater, there is currently no acceptable method to predict these types of impacts. A concentration that produces nuisance aesthetic impacts from hydrocarbons C₁₀ - C₃₂ would have to be established. However, if an impact did occur that adversely effected the use of the water, the Department could require a mitigation response action in accordance with A.R.S. § 49-286.

RESPONSE: No change to the rule.

7. Groundwater Condition; Applicability

ISSUE: Do soil concentrations protective of groundwater quality (GPLs) apply only to the area where contaminants are within 10 meters of groundwater? Would SRLs be the applicable cleanup standards for the remainder of the site or would the GPLs apply to the entire site?

ANALYSIS: The rule's requirement to protect groundwater quality applies regardless of the depth of contamination and applies throughout the vadose zone. The rule does not limit this requirement based on a particular distance between the soil contamination and groundwater. For guidance purposes, the Department developed a model to evaluate potential impacts to groundwater quality from soil contamination. This model was used to develop GPLs in the guidance document, "A Screening Method to Determine Soil Concentrations Protective of Groundwater Quality." Modeling was performed using default assumptions to develop Minimum and Alternative GPLs for commonly occurring groundwater contaminants. The input to the GPL model includes a parameter based on a compound's potential to degrade in the vadose zone and aquifer (the half-life). For compounds that typically biodegrade such as benzene, toluene, ethylbenzene and xylene (BTEX), the degradation half-life is 1,000 days. As a result, the model predicts that the direct risk to human health (Residential HBGLs) is greater than the potential indirect impacts to groundwater (Alternative GPLs) if there are at least 10 meters between the BTEX contamination in the soil and the water table for the default conditions. Under this rule-of-thumb relationship, the residential HBGLs for BTEX are usually the appropriate cleanup standards when groundwater is greater than 10 meters below the last analytical detection of contamination. This relationship does not apply to other compounds and will not apply to the SRL for benzene under the Final Rule.

RESPONSE: No change to the rule.

8. Groundwater Condition; Leachability Guidance

ISSUE: The leachability screening guidance levels, or GPLs that the Department has published for use in demonstrating protection of groundwater quality, create a false sense of security for responsible parties as well as the general public. The Department states in the guidance that the model selected has its limitations and would be affected by site-specific parameters, such as coarse-grained soils or an increase in organic carbon or moisture content. For example, a homogeneous sand is used for the model. Obviously sites with coarse-grained sand, gravel and/or cobbles, which are common in Arizona, would not be protective under this scenario.

Commenters had the following specific concerns with the leachability guidance:

It is a requirement of R18-7-203(B)(1) that after remediation to a pre-determined standard or a level derived from a site-specific risk assessment, the remediating party must determine if the levels of contamination cause a water quality violation. For most people, this requirement is interpreted to mean meeting the GPLs. Therefore, if the remaining constituents are at concentrations that are less than the SRLs and/or GPLs, it is commonly believed that no further action (investigative or remedial) is required at the site. It must be made very clear that the requirements of this subsection are not necessarily met when contaminant concentrations remaining in soil are below the GPLs.

Commenters were concerned that the model does not consider the concentration in groundwater at the source. This is not a problem for most programs within the Department where the point of compliance can be negotiated or where the property is large

enough that the release and resultant impacted groundwater plume remain on the property. However, the point of compliance in the UST program is at the water table, thus the model and subsequent default values are not protective of groundwater under this program. In addition, given the size of most service stations, convenience stores or dry cleaners, 100 feet from the source is typically beyond the property boundary. Therefore, a problem may be created that will require a much more extensive and expensive characterization and remediation than would be required if the contamination was remediated in the vadose zone. Once again, this is not clear in the guidance and the general public and the regulated community will accept the default values in the guidance as protective and consider their investigation or remediation completed.

One commenter stated that the leachability model does not consider vapor phase transport of constituents that fill the soil pore spaces. This is probably the major contributor to the groundwater contamination that is apparent on sites with low soil contaminant concentrations. In addition, the transition between the vapor phase and liquid phase (the volatile compound migrating to the groundwater) occurs readily, even more easily than from the soil grains to groundwater. Therefore, much of the groundwater contamination that is observed may be due to the volatile constituent entering the groundwater. This is not accounted for in the model and as a consequence the default values may be less protective of groundwater than the model indicates.

Based upon the default standards for BTEX, commenters suggested that a remediating party may leave levels of hydrocarbons in place, within 10 meters of the water table, that may migrate to, and contaminate groundwater to a level that will require cleanup. There are numerous examples of sites that have impacted groundwater that have benzene concentrations at levels less than the default value of 0.71 mg/kg in the soil zone within 10 meters of the water table, that have exhibited concentrations of benzene in the groundwater at levels above the AWQS of 5 micrograms per Liter ($\mu\text{g/l}$).

ANALYSIS: The guidance GPLs were calculated assuming some generic soil characteristics. If these assumptions are not correct for a particular site (for example, coarse-grained or gravelly soils, fractured bedrock) then the resultant GPLs are not applicable. The guidance specifies the assumptions that were made in determining the default characteristics. It also specifies some conditions where use of the GPLs calculated with the model are not appropriate. It is the responsibility of the users of the guidance (both regulated community and Department staff) to be aware of the limitations of the model and the site characteristics before using the guidance and/or model. Additionally, the GPLs are generated using a model that simplistically simulates complex natural conditions. Therefore, if the GPLs predict no potential threat to groundwater quality but groundwater data indicate that an impact has occurred or will occur, the predictive results will give way to the real data, and additional remediation will be required.

The ADEQ model was used to generate the Minimum and Alternative GPLs listed in the guidance document. This model evaluates transport of organic compounds by liquid-phase convection and diffusion and vapor-phase diffusion (Please see the guidance document, "A Screening Method to Determine Soil Concentrations Protective of Groundwater Quality").

RESPONSE: No change to the rule.

9. Leachability Guidance

ISSUE: One commenter expressed concern that the guidance for determining soil concentrations that are protective of groundwater quality allows contaminants to reach groundwater. They felt that the GPLs should be conservative enough to ensure that groundwater was not impacted at all.

ANALYSIS: ADEQ's interpretation of its statutory responsibility to protect groundwater is based on protecting the use of the aquifer. In Arizona, all aquifers are protected for drinking water use, therefore, the relevant standards for protection of that use are the AWQS. Numeric AWQS are equivalent to the drinking water MCLs. Compliance with these standards is determined at a specific point or points within the aquifer. The practical application of this interpretation is that some contamination may reach groundwater as long as groundwater does not exceed an AWQS at point(s) designated by each program to measure compliance.

RESPONSE: No change to the rule.

10. Surface Water Quality Condition

ISSUE: For clarification, this section should be revised to read as follows:

2. Cause or threaten to cause a violation of an applicable Water Quality Standard for the receiving water as established pursuant to Title 18.

In addition, Subsection (B)(2): "... Title 18 ..." should be prefaced with "A.A.C." For consistency with subsection (B)(1) it should parallel requirements for narrative standards at R18-11-108, and, if allowed, for development of alternative soil remediation levels.

ANALYSIS: The Department agrees that this condition should parallel the requirements for the groundwater condition. In doing so, the term "receiving water" is not needed.

RESPONSE: R18-7-203(B) is revised as follows:

- B. A person who conducts a soil remediation based on the standards set forth in R18-7-205 or R18-7-206 shall remediate soil so that any concentration of contaminants remaining in the soil after remediation does not:
 1. Cause or threaten to cause a violation of Water Quality Standards prescribed in 18 A.A.C. 11. If the remediation level for a contaminant in the soil is not protective of aquifer water quality and surface water quality, the person

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shall remediate soil to an alternative soil remediation level that is protective of aquifer water quality and surface water quality.

11. Nuisance Condition

ISSUE: The Rule should specify criteria that ADEQ or a remediating party can apply to determine if a nuisance has been or will be caused. Otherwise, this issue is subject to debate without satisfactory resolution.

ANALYSIS: A subcommittee of the Cleanup Standards/Policy Task Force (Task Force) provided recommendations on nuisance criteria for guidance or for inclusion in the rule. There was no consensus by the Task Force on those recommendations due to the fact that they could not be applied consistently. The Department agrees that if a condition is placed in the rule, there should be criteria for a remediating party to demonstrate that a nuisance has not been caused. Due to the lack of criteria, the condition will be deleted from Section 203. However, the Department will add a provision to the rule that will allow the Department to require further action if a nuisance is caused by contaminants remaining in the soil. Please see Issue #12 in R18-7-201.

RESPONSE: R18-7-203(B)(4) is deleted.

12. Ecological Condition

The Department received numerous comments on the proposed definition of "ecological receptors" as well as the condition in R18-7-203(B)(5). The comments on the proposed definition can be found in Issue #6 in R18-7-201. This section will address issues specific to the condition.

Several commenters pointed out that the issue of what constitutes a "sensitive environment" was discussed at length by the Task Force and its working groups. In the Interim Soil Remediation Standards Rule, the Department proposed a draft definition of "sensitive environments" which was not as broad as the current proposed definition of "ecological receptors." Even so, the Department acknowledged in the Concise Explanatory Statement for the Interim Rule (CES) that "needless expense and delay could result under the proposed screening criteria because a large percentage of sites which truly pose no threat to the environment would remain after screening." As a result of discussions regarding this issue, the Department agreed that compliance with surface water quality standards would be added as a screening criteria, and the term "sensitive environment" would be deleted. As the Department acknowledged in the CES, this approach provided "adequate protection for the sensitive environments" and "there would be few sensitive sites, if any, that will not fall under the purview of these requirements."

Commenters continued by adding that the Department has failed in the proposed rule and in any meeting of the Task Force or of its stakeholders' groups to provide any specific reasons for assuming that the existing surface water quality screening criteria does not remain protective of "ecological receptors." Rather, the Department has decided to repropose the surface water screening criteria and to add the "ecological receptor" requirement which suffers from the same defects as the proposed interim rule.

Others stated that the rule is ambiguous as to how this screening requirement can be satisfied which will unnecessarily force parties into performing ecological risk assessments. The proposed rule also provides little guidance on what constitutes an acceptable ecological risk assessment or what methods will be used to develop an alternative remediation standard. Ecological risk assessments are a relatively new concept and are fraught with uncertainty. In its recent notice of availability of proposed guidelines for ecological risk assessments, for example, EPA conceded that "the contents of the Proposed Guidelines are limited by the present state of the science and the relative lack of experience in applying risk assessment principles to some areas." See 61 FR 47552 and 47553 (Sept. 9, 1996). The requirement that an ecological risk assessment be performed places a potentially enormous burden on a remediating party without any guidance in the rules for making this determination.

Several commenters indicated that although the Department has indicated that it plans to issue guidance for making these "ecological risk" screening determinations as well as guidance on ecological risk assessments, the lack of guidance in the rules combined with the broad definition of "ecological receptor" renders the entire ecological risk portion of the proposed rules extremely problematic. They recommended that ADEQ should withdraw the concept of ecological risk from the rules until the Department has had a chance to further refine its thinking regarding ecological receptors and ecological risk assessments. If that approach is not acceptable, several suggested the following specific changes to the proposed rules: 1) delete the problematic definitions of "ecological receptor" and "ecological risk assessment"; and 2) modify proposed A.A.C. R18-7-203(B)(5) to read:

Cause or threaten to cause an adverse impact to wetlands or riparian habitat at the site, or to 1 or more members of a species listed as endangered under the Endangered Species Act of 1973, 16 U.S.C. § 1531 et seq., that is present at the site. The potential for adverse impact shall be evaluated based on the contaminant's ability to bioaccumulate, an evaluation of exposure pathways, and other relevant site-specific factors. If the remediation level for the contaminant threatens to cause adverse impact under this paragraph, the person shall remediate to an alternative soil remediation level. A scientifically valid demonstration shall be made to determine an alternative soil remediation level and shall include site-specific and contaminant specific characteristics.

In contrast, several other commenters indicated that the screening criteria listed were not protective enough. They stated that bioaccumulation and demonstration of completed pathways are insufficient to determine ecological impacts and should not remain the exclusive criterion on which to support an ecological risk analysis. A number of inorganic and organic substances have been determined to not bioaccumulate or bioconcentrate, yet pose a substantial risk when exposed to ecological receptors in an uncontrolled manner. Other factors and effects can include, but are not limited to, acute toxicity, lethal effects, mutagenic effects, teratogenic effects, carcinogenic effects, loss of habitat, loss of diversity, and food chain impacts. In addition, demonstration of completed pathways is necessary, but often insufficient to determine ecological impacts. In general, ecological risk

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management should focus on ecological endpoints and impacts, both on-site and off-site, for a variety of receptors based on their sensitivity.

One commenter indicated that due to the fact that specifics regarding the evaluation of groundwater and surface water impacts are not provided, specifics for ecological impacts should not be provided. Therefore, Subsection 5) should be revised to eliminate (a) and (b).

ANALYSIS: As indicated in the comments, the Department did attempt to propose an ecological condition for the Interim Soil Remediation Standards Rule and, as was pointed out, the condition was not included in the adopted Interim Rule. It was not included because of the limited time in which the Department had to adopt the Interim Rule. The Department acknowledged in the CES to the Interim Rule that the Surface Water Quality Standards would be added as a condition because they are protective of most "sensitive environments." The Department also stated that this issue will continue to be explored for the Final Soil Remediation Standards Rule.

Since that time, the Department held several Task Force meetings and subcommittee meetings on this issue. The Task Force indicated strongly that it has always anticipated some ecological component to the rule (1994 "Compromise Proposal") and stated that A.R.S. § 49-152(A) refers to soil remediation levels that protect public health and the environment. If the Surface Water Quality Standards are not fully protective of the ecological resources, the Department must add an additional requirement.

The Arizona Water Quality Standards for Surface Waters (R18-11-109) are designed to protect the public and the environment against toxicants that may be dissolved or otherwise suspended within the water column. Sediments deposited within a water body from adjacent land may contain toxicants adsorbed onto the particles that, once within the water body may bioaccumulate through the food chain to toxic levels in apex predators, such as the great blue heron, the Yuma clapper rail, or the bald eagle.

Such a toxicant is the organochlorine, DDT, and its metabolites, DDD and DDE. This toxicant and its metabolites are hydrophobic, adsorb strongly to soil particles and are rarely found in the water column. They are also extremely lipophilic and able to bioaccumulate, readily move through the food chain, and accumulate at toxic levels in apex predators. A 1994 Priority Pollutant Program survey in the Dysart Drain found DDE concentrations in the tissues of the common carp (*cyprinus carpio*) at 5 times the FDA action level, while concentrations in the sediments were well below the HBGL. Many toxicants have similar properties of bioaccumulation and hydrophobicity. Surface Water Quality Standards alone cannot protect the public and the environment against these hazards.

As a result, the Department proposed a definition of "ecological receptor" and a requirement that any contaminant concentrations remaining in the soil after remediation could not adversely impact ecological receptors. Screening criteria were also listed to facilitate a demonstration that receptors had not been impacted. In addition, the Department proposed to develop guidance to aid in the demonstration. Unfortunately, as indicated by the comments, the definition and the criteria would still require a large number of sites to make the demonstration. In addition, the guidance which may have given reassurance to the commenters is not completed at this time.

The Department received several suggestions to modify or delete the definition of "ecological receptor" and the ecological condition. The suggested language on the definition is addressed in Issue #6 in R18-7-201. The suggested language on the condition listed above recommends narrowing the focus of ecological protection to wetlands, riparian areas, and to endangered species. A.R.S. § 49-152(A) does not give the Department the discretion to ignore or exclude any ecological receptors or ecosystems. In addition, the proposal does not reflect the Task Force's desires. Therefore, the suggested language cannot be adopted. Other comments suggested adding additional factors to the screening criteria. Due the problems stated previously, the Department cannot adopt these additional factors.

As stated above, the Department believes it must retain an ecological component in the rule. Due to difficulties in establishing screening criteria, a provision will be added to the rule which will allow the Department to require further action if contamination remains in the soil which causes or threatens to cause an adverse impact to ecological receptors. Further action may include assessment or remediation. It should be noted that remediation does not necessarily entail treatment or removal of soil. Remediation could include elimination of a complete exposure pathway, such as installing a cap. It should also be noted that the Department already has authority under the general Departmental duties or individual program authority to protect the environment, but only a handful of ecological risk assessments have ever been required.

In order to determine if ecological receptors have or could be impacted, the Department will evaluate whether a pathway exists for a contaminant to reach an ecological receptor. If the Department determines that an adverse impact to an ecological receptor exists, an ecological risk assessment will be required.

RESPONSE: R18-7-203(B) is revised as follows:

3. Cause or threaten to cause an adverse impact to ecological receptors. If the Department determines that the remediation level for a contaminant in soil may impact ecological receptors based on the existence of ecological receptors and complete exposure pathways, the person shall conduct an ecological risk assessment. If the ecological risk assessment indicates that any concentration of contaminants remaining in the soil after remediation causes or threatens to cause an adverse impact to ecological receptors, the person shall remediate soil to an alternative soil remediation level, derived from the ecological risk assessment, that is protective of ecological receptors.

R18-7-204. PRE-DETERMINED REMEDIATION STANDARDS

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1. Title

ISSUE: The term "Pre-determined Remediation Standards" should be deleted. It is confusing to add another term which is identical to Soil Remediation Levels (SRLs). A generic description which would indicate that SRLs are pre-determined standards is acceptable, but an official capitalized title is confusing and redundant.

ANALYSIS: A.R.S. § 49-151 et seq. uses the term "pre-determined risk-based standards" to differentiate between "off-the-shelf" remediation levels and remediation levels derived from a site-specific risk assessment. The term "SRL" is used by the Department to refer to those levels calculated in accordance with the statutory mandate for the final rule and to distinguish them from the HBGLs used in the Interim Rule.

RESPONSE: No change to the rule.

2. Selection of Remediation Standards

ISSUE: The rule and the Preamble are unclear whether the responsible party or property owner has authority to select the remediation standard for a particular site. For example, R18-7-204(A) simply provides that "A person may elect to remediate to the SRL's set forth in Appendix A." This makes it appear that the responsible party conducting the remediation may select either a residential or a non-residential SRL. In subsection E, the rule states that "a person choosing to remediate to the non-residential SRL shall comply with R18-7-206." R18-7-206(A) provides that a person must record a Voluntary Environmental Mitigation Use Restriction (VEMUR) in accordance with A.R.S. § 49-152 as set forth in Appendix B. These provisions create confusion because they might be interpreted to allow a responsible party who is not the property owner to file a VEMUR with the county recorder's office.

A.R.S. § 49-152(B) is clear in providing that the owner of the property being remediated who has voluntarily elected to remediate the property for non-residential uses shall record a VEMUR. Only property owners may record a VEMUR restricting the use of the property. Therefore, the rule should clearly provide that only the property owner may select whether the remediation will meet the residential or non-residential remediation standards. Further, the rules should provide some process whereby the property owner is notified that a remediation is taking place and is provided an opportunity for comments and approval of the remediation. As the party most affected by the long-term impacts of a remediation, the landowner should be ensured of input and approval of remediation conducted by a responsible party.

ANALYSIS: In this rule, the definition of "person" is very broad but does not indicate whether or not a particular person is the property owner. In many instances, the person responsible for remediation of soil contamination may not own the contaminated property. However, the Department agrees that the statute clearly indicates that only the property owner may record a VEMUR since the VEMUR requires the property owner's signature. Therefore, the person who remediates the site, if not the property owner, must obtain concurrence from the property owner to remediate to non-residential standards in order to file the required VEMUR. Please see Issue #5 in R18-7-206 for further discussion.

RESPONSE: Please see Issue #11 in R18-7-206 for rule text revisions.

3. Remove the Residential/Non-Residential Distinction

ISSUE: Several commenters suggested that there should be only 1 set of SRLs that would apply for both residential and non-residential properties. They expressed concern that non-residential cleanup standards remove an incentive for the non-residential property owner to prevent releases. Placing a VEMUR on a property to restrict its use may not always be the best land use policy, particularly within city limits, because it prevents properties from being sold or redeveloped due to the potential liabilities resulting from contamination beneath the property. The immediate threat to human health may be less on a non-residential property, but the environmental effects are the same. In addition, many "non-residential" sites, such as gas stations, may be located within essentially residential neighborhoods.

ANALYSIS: A.R.S. § 49-152 requires the Department to establish separate remediation standards for residential and non-residential use. Although there may be potential impacts on property value and marketability once a VEMUR is placed on that property, these should be considered when the land owner elects remediation to non-residential standards. However, there are many properties that have a history of commercial/industrial use that will attract similar future use. The rule provides options for cleanup levels for those properties consistent with the land use. In addition, remediations will not be approved by the Department if they leave soil contamination at levels that pose an environmental risk, regardless of residential or non-residential land use.

RESPONSE: No change to rule.

4. Cost-Effectiveness and Technical Feasibility

ISSUE: The more stringent default soil remediation levels are only appropriate within the context of a scientifically sound, well defined and consistently applied risk-based system in which the Soil Remediation Levels are viewed as the equivalent of tier 1 standards within an ASTM-type risk based corrective action (RBCA) system. Such a system must also consider technical feasibility and cost-effectiveness. It is recommended that the new SRLs go into effect only after such a system has been fully developed and implemented.

ANALYSIS: The Department believes the SRLs can be viewed as similar to tier 1 standards within the individual programs. However, the soil rule only establishes standards to answer the question of "How clean is clean?" Decisions about the selection

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of the SRLs as the cleanup standards for a particular site are made by the party conducting the remediation. These decisions should incorporate an evaluation of cost effectiveness and technical feasibility and may be made without Department involvement (Please see Issue #6 in R18-7-205). Additionally, the rule does not define the remedial measures undertaken to achieve the selected levels. Generally, cost effectiveness and technical feasibility are evaluated when selecting the remedial action - a part of the remediation process not contemplated in this rule.

RESPONSE: No change to the rule.

5. SRL's; Conservative Methodology

ISSUE: A number of comments were received on the methodology used to calculate the SRLs. Specifically, some commenters suggested that the health risk evaluation was overly conservative. They believed that the use of the PRG guidance was inappropriate because the PRGs are a screening tool for initial analysis of a site as part of the feasibility study described in 40 CFR 300.430(e)(2)(I). The PRGs are the point of departure for more refined analysis and were not intended themselves to be the final standard. Therefore, the degree of rigor and analysis used to develop the assumptions and equations is not necessarily sufficient to set final cleanup standards. A "reality check" or feasibility analysis should be incorporated into the standard development.

ANALYSIS: The SRLs are calculated using a human health-based approach that is generally consistent with risk assessment methodologies recommended by the EPA and the ADHS. The standards include exposure pathways for which commonly accepted methods, models, and assumptions have been developed (that is, ingestion, inhalation, and dermal contact) for residential and non-residential land-use conditions. The Department acknowledges that the SRLs are conservative values for soil cleanups. However, developing "off-the-shelf" standards that can apply to a wide variety of sites under a range of site conditions required conservative assumptions. Based on comments received when the approach was originally presented to the Task Force, the Department modified the USEPA Region IX PRGs to adapt them as remediation levels. These changes include: new SRLs for arsenic (Please see Issue #17); SRLs for hydrocarbons C₁₀ - C₃₂ (Please see Issue #20); and an allowance for free-phase to occupy up to 1% of the pore volume (Please see Issue #14).

RESPONSE: No change to the rule.

6. Risk Management Level for SRLs

ISSUE: A number of comments were received on the risk levels used to calculate the SRLs. Some commenters supported the Department's decision to calculate the SRLs for Class A carcinogens based on an excess lifetime cancer risk (ELCR) of 1×10^{-6} , other classes of carcinogens based on an ELCR of 1×10^{-5} , and systemic toxicants at a Hazard Quotient of 1. However, some commented that there is no legitimate scientific basis for using the 1×10^{-6} level to set cleanup standards. An excess cancer risk of 1×10^{-5} for all contaminants, including Class A carcinogens, not only will be protective of human health, but it will result in the establishment of reasonable and practical cleanup levels. The Department's decision to calculate SRLs for Class A carcinogens at a 1×10^{-6} risk not only diverges from the preferred alternative of the Arizona Department of Health Services (ADHS) selected in mid-1995 and approved by almost all the members of the Task Force, but it creates cleanup levels for certain substances which are too stringent and which result in bad public policy as well. In addition, ADHS has publicly stated that a 1×10^{-5} ELCR is more than adequate to protect public health. The adoption of a more stringent limit in the face of an ADHS opinion to the contrary is of significant concern.

Commenters defended a 1×10^{-5} excess cancer risk as proper to use for developing all SRLs because that level is within the range (10^{-4} to 10^{-6}) established by USEPA and the State of Arizona (A.R.S. § 49-152) as being protective of human health. In fact, it was pointed out that USEPA has chosen a risk of 1×10^{-5} or greater as the residential soil cleanup level for Superfund sites, including the Anaconda site in Montana. In addition, USEPA (and the State) have adopted a number of maximum contaminant levels (MCLs) for the protection of drinking water supplies based on risks greater than 1×10^{-6} .

Commenters also faulted the Department for focusing exclusively on the excess cancer risk (1×10^{-6} vs. 1×10^{-5}). They felt that approach was misleading because those risk levels do not properly reflect the risks to public health under the SRLs for a number of reasons. The PRG methodology to calculate the SRLs overestimates the risks to human health in a number of ways through conservative carcinogenicity and toxicity factors as well as conservative exposure assumptions. For example, calculation of the SRLs assumes that exposure occurs regularly, for residential uses, 350 days per year for a 30-year period through the ingestion, inhalation, and dermal pathways. This means that a person, based on residential exposure: 1) ingests 0.12 grams of the chemical, 2) inhales a chemical-specific amount of the chemical, and 3) absorbs through dermal exposure a calculated amount of the chemical (based on the ingestion rate) 350 days per year for 30 years. The probability that this level of exposure actually occurs far exceeds 1×10^{-6} .

The commenters stated that these conservative assumptions are combined with conservative assumptions regarding the amount of exposure to the chosen contaminant through each of these exposure pathways. For example, the model used by the Department to estimate exposures through the inhalation pathway assumes that the chemical contamination extends up to the ground surface, even though, in many cases, there is a layer of uncontaminated earth between the contaminant source and the ground surface (for example, where an underground storage tank has leaked). The inhalation model also assumes that some portion of the chemical creates an exposure for a 30-year period, that none of the chemical is affected by water infiltration, and again that

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the receptor inhales the chemical 350 days per year. In addition, the SRLs assume exposure through dermal absorption, even though no reliable evidence on the health impacts of exposures through that pathway exists (Please see Issue #7).

Others indicated that the main "Class A" carcinogens affected by the Department's decision to use a 1×10^{-6} excess cancer risk level for the SRLs are benzene and arsenic. These 2 substances are often present at sites requiring soil remediation, benzene at gasoline underground storage tank (UST) sites and arsenic at many industrial sites. Given this fact, the Department's decision to calculate the SRLs based on a 1×10^{-6} excess cancer risk will have serious public policy implications.

Commenters focused on benzene as an example. The proposed SRL for benzene reduces the residential cleanup level from the existing HBGL of 47 mg/kg to 0.62 mg/kg, an almost 100 fold decrease. The adoption of the proposed SRL for benzene would be bad public policy given its potential impact on the allocation of the scarce resources of the state assurance fund (SAF). Parties who seek reimbursement from the SAF will be required to remediate soils to excessively stringent concentrations. Although parties will have the option to perform a risk assessment, that cost also will be borne by the SAF.

ADEQ should also consider that unreasonably stringent soil remediation standards could expose the State to unnecessary financial risk and substantial financial obligations that would deplete WQARF funds. During the 1997 legislature, the WQARF law was overhauled in SB 1452. Among the reforms in this law, there is a program for WQARF to fund a significant share of the costs of many cleanups. In addition, WQARF response actions conducted by ADEQ must meet the same cleanup standards as private party cleanups. Overly stringent standards and excessively costly cleanups may needlessly deplete the limited WQARF funds that are needed for other sites.

CERCLA also provides that the state is responsible for a certain share of the cleanup costs for response actions taken pursuant to section 104 of CERCLA. 42 U.S.C. § 9604(c)(3); 40 CFR 300.510. There are other circumstances where the state may be required to pay a portion of a response cost under CERCLA. 42 U.S.C. § 9621(d)(2)(iii)(III).

ANALYSIS: The Task Force was unable to reach consensus on the methodology for final pre-determined risk-based remediation standards proposed by ADHS except that the final standards should add the inhalation exposure route that was not considered in the Interim Rule. Following presentations on the positions of Task Force members, the decision was deferred to the Director of ADEQ. In addition to reviewing recommendations from Task Force members (including ADHS), the Director convened several meetings with outside health experts not previously involved in the process. The Director decided to use an ELCR of 1×10^{-6} for calculating SRLs for Class A carcinogens and an ELCR of 1×10^{-5} for other carcinogens, and a hazard quotient no greater than 1. The Director's decision represents an effort to balance the public's concerns about potential exposure to known cancer-causing contaminants with the need to encourage the regulated community to undertake cleanups. The Department has elected a conservative approach for 10 contaminants on the SRL list that are known to pose a risk of cancer to humans (Please see Issue #17 for more discussion on arsenic).

The Department recognizes the range of risk levels established by USEPA and referenced in the statute. The selection of the soil cleanup level for the Montana Superfund site was based on a site-specific risk assessment, not the pre-determined standards (SRLs) discussed here. The rule provides the option to conduct a site-specific risk assessment to develop remediation levels that may be less stringent than the SRLs, but fall within USEPA's acceptable risk range. Additionally, the Department recognizes that many programs, including drinking water, use some standards based on risks greater than 1×10^{-6} .

The Department also acknowledges that the SRLs are conservative values for soil cleanups. Developing "off-the-shelf" standards that can apply to a wide variety of sites under a range of site conditions required conservative assumptions. When developing the SRL for benzene, for example, it would be inappropriate for the Department to assume that no sites will have benzene at the surface. Based on comments received when the approach originally was presented to the Task Force, the Department modified the USEPA Region IX PRGs to adapt them to use as remediation levels including: new SRLs for arsenic (Please see Issue #17); SRLs for hydrocarbons $C_{10} - C_{32}$ (Please see Issue # 20); and allowance for free-phase to occupy up to 1% of the pore volume (Please see Issue #14).

The SRLs are calculated using a human health-based approach that is generally consistent with risk assessment methodologies recommended by the USEPA and the ADHS. The SRL calculations use USEPA non-carcinogenic reference doses (RfD) and carcinogenic slope factors (SF) from the USEPA Integrated Risk Information System (IRIS) through July, 1996, USEPA Health Effects Assessment Summary Tables (HEAST) through May, 1995, and the USEPA National Center for Environmental Assessment (NCEA). Route-to-route extrapolations were used when no toxicity values were available for a given route of exposure. For example, oral cancer slope factors and reference doses were used for oral and inhalation exposure when organic compounds lacked inhalation values. Inhalation slope factors and inhalation reference doses were used for oral exposure for organic compounds lacking oral values. In addition, oral toxicity values were used for calculating risk and hazard from dermal exposures. The default exposure factors for ingestion, inhalation, and dermal exposure pathways under residential and non-residential land-use conditions were obtained primarily from *Risk Assessment Guidance for Superfund (RAGS), Supplemental Guidance Standard Default Exposure Factors* (OSWER Directive, 9285.6-03) dated March 25, 1991 and more recent information from USEPA's Office of Solid Waste and Emergency Response, and the USEPA Office of Research and Development.

The Department did consider impacts to both the SAF and to WQARF in the development of the SRLs, as well as the statutory mandate to adopt standards that are protective of human health and the environment. As stated previously, only 2 of the 12 Class A carcinogens are seen frequently during soil remediations: arsenic and benzene. The arsenic SRL is being modified for a number of reasons (Please see Issue #17). In regard to benzene, it should be noted that the UST Suggested Soil Cleanup Levels (SSCLs) for benzene before the Interim Soil Remediation Standards Rule was 0.13 mg/kg. Add the fact that groundwater con-

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siderations rarely allow benzene soil concentrations to remain at 47 mg/kg and the net change is very small. As a result, the impacts caused by the final SRL for benzene to either the SAF or WQARF are minimal.

RESPONSE: No change to the rule.

7. Dermal Exposure Pathway

ISSUE: Although some commenters agreed with the Department's approach to include the dermal pathway in calculating the SRLs, several comments were received that the Department should eliminate the use of the dermal pathway. They stated that the Department's decision to include the dermal exposure pathway not only conflicts with the methodology proposed by ADHS and approved by the Task Force in 1995, but ignores the fact that, as USEPA has acknowledged in describing the PRG methodology, "...much uncertainty surrounds the determination of hazards associated with skin contact with soils." This uncertainty exists, in part, because there is a "lack of EPA verified toxicity values for the dermal route." (USEPA Memorandum, "Region 9 Preliminary Remediation Goals (PRGs) 1996," August 1, 1996).

In addition, they stated that USEPA's Dermal Exposure Assessment Guidance (USEPA, 1992) indicates that results of the evaluation of the dermal exposure pathway should be interpreted with caution because the dermal pathway for constituents originating in soil is so uncertain and the predictive methods have not been validated. Some of the issues related to dermal absorption of constituents from soil involve the transfer mechanism of the constituent from the soil particle surface to the skin surface followed by absorption through the skin. While on the soil or skin surface, the volatile constituents may vaporize and not be available for absorption through the skin. Additionally, the mechanism for this transfer is not well understood. Some of the experimental studies have involved application of a constituent onto the skin surface. These results would not be directly comparable to application of a constituent in soil to the skin surface. Because of the uncertainties involved in evaluating this exposure pathway, the dermal pathway should be excluded from evaluation of exposure of constituents in soil.

Others indicated that USEPA Region IX and the Department have taken the oral ingestion toxicity values and simply extrapolated them for use in calculating risks through dermal exposures. This is an extrapolation which USEPA itself admits is not always appropriate. Given this uncertainty, USEPA Region III risk-based concentrations (RBCs) do not include a dermal exposure pathway, and USEPA used a dermal pathway only for pentachlorophenol in developing its Soil Screening Levels. In addition, no dermal exposure equation is provided in USEPA's "Risk Assessment Guidance For Superfund: Volume 1 - Human Health Evaluation Manual." Rather than compounding USEPA Region IX's error in using the dermal exposure pathway without adequate scientific support, the Department should calculate the SRLs based on the ingestion and inhalation pathways alone as recommended by ADHS and as accepted by the Task Force in 1995.

Another commenter indicated that ADEQ's proposed SRLs differ from USEPA's PRGs because of the inclusion of dermal contact. They stated that ADEQ has proposed a risk level of 1×10^{-5} for carcinogens other than Class A compared to the 10^{-6} risk level used to develop the PRGs. This order of magnitude increase in acceptable risk should translate into an order of magnitude higher cleanup level. Thus, while USEPA Region IX might have a PRG for trichloroethene (TCE) of 7.1 mg/kg, ADEQ would have a remediation level of 71 mg/kg for residential if the equations used by ADEQ were identical to the Region IX PRGs. However, they are not, and the ADEQ proposed level is 27 mg/kg. The commenter concluded that the difference is due to the fact that ADEQ includes the dermal exposure pathway in developing the proposed SRLs, while USEPA does not.

Finally, 1 commenter expressed concern that the use of the dermal exposure factor appreciably lowers the SRL for a number of pesticides without providing any corresponding health benefits (given the acknowledged uncertainty of the exposure) and unnecessarily adds to the cost of residential housing.

ANALYSIS: The Task Force was unable to reach consensus on the methodology for final pre-determined risk-based remediation standards proposed by ADHS except that the standards should incorporate the inhalation exposure route. Following presentations on the positions of Task Force members, the decision was deferred to the Director of ADEQ. In addition to reviewing recommendations from Task Force members (including ADHS), the Director convened several meetings with outside health experts not previously involved in the process. The experts expressed concern that the ADHS 1995 proposal did not include several obvious exposure routes, most notably dermal. As a result, the Director decided to include the dermal route of exposure in calculating the SRLs. It should be noted that any party may complete a site-specific risk assessment that independently evaluates the merits of including or excluding dermal exposures in setting site-specific remediation levels.

The Department acknowledges that much uncertainty surrounds the determination of hazards associated with skin contact with soils. However, the dermal pathway is still evaluated by USEPA in making risk determinations. Although dermal contact is excluded from the calculation of USEPA's Soil Screening Levels (SSLs), USEPA's Soil Screening Guidance recommends that risks associated with additional pathways or conditions (including dermal contact) be considered to determine whether the SSLs are adequately protective (Soil Screening Guidance: Technical Background Document, USEPA, 1996). The August 1, 1996 USEPA Region IX PRGs also incorporate dermal exposure in their assessment of exposure.

In regard to differences between the PRGs and the SRLs, SRLs use the same assumptions for dermal exposure as the August 1, 1996 Region IX PRGs. SRLs are calculated for carcinogenicity (excess lifetime cancer risk of 1×10^{-6} or 1×10^{-5}) and systemic toxicity (Hazard Quotient of 1). For carcinogens, the listed SRL represents the lowest concentration level based upon systemic toxicity or carcinogenicity. In the case of TCE, the non-cancer risk (systemic toxicity) level is exceeded when the cancer risk level is increased to 1×10^{-5} . Therefore, the residential SRL for TCE is 27 mg/kg based upon systemic toxicity, not carcinogenicity.

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In order to determine the impact of including the dermal pathway, ADHS has analyzed the contribution of dermal contact exposures in calculating the SRLs. The results indicate that dermal exposure has no significant impact on residential SRLs for inorganics and volatile organic contaminants. The largest impact of the dermal pathway is on SRLs for nonvolatile organic compounds, including pesticides. However, even for nonvolatile organics, the residential SRL would only increase between 20% to 44% if dermal contact was excluded. For example, the most commonly detected pesticides in Arizona soils are toxaphene and DDT. Excluding dermal contact exposure from the residential SRL for toxaphene would increase the SRL from 4 mg/kg to 5.8 mg/kg. The residential SRL for DDT would increase from 13 mg/kg to 19 mg/kg. In contrast, the Interim Rule listed residential HBGLs for toxaphene and DDT at 1.2 mg/kg and 4.0 mg/kg, respectively. The following table illustrates the impact of the dermal contact exposure route on the SRLs for some commonly occurring contaminants:

Contaminant (Type)	Final SRL		SRL Without Dermal Contact	
	Residential	Non-residential	Residential	Non-Residential
Inorganics:				
Cadmium	38.0	850.0	39.0	1000.0
Chromium (total)	2100.0	4500.0	2100.0	4500.0
Volatile organics:				
Benzene	0.62	1.4	0.63	1.4
Ethylbenzene	1500.0	2700.0	1600.0	2700.0
Toluene	790.0	2700.0	800.0	2700.0
Xylene	2800.0	2800.0	2800.0	2800.0
PCE	53.0	170.0	63.0	220.0
TCE	27.0	70.0	27.0	72.0
Non-volatile organics:				
DDT	13.0	56.0	19.0	170.0
Toxaphene	4.0	17.0	5.8	52.0

The Department believes that by evaluating the dermal contact exposure route in the development of the SRLs, the Task Force's intent to develop conservative pre-determined standards is preserved. In addition, it is also believed that the inclusion of the dermal route does not present an undo burden on remediation or residential housing costs. Additional routes of exposure (migration of organic vapors into buildings, consumption of garden vegetables, raising of livestock, fish consumption) could exist at any particular site, but are not included in the SRLs.

RESPONSE: No change to rule.

8. SRLs; Acute Toxicity

ISSUE: One commenter stated that the approach to developing SRLs is a very narrow and simplistic view of what practical and real soil cleanup standards should be. This approach seems to ignore acute toxicity indexes. For example, the standard for barium cyanide in non-residential soil is 17%. Barium cyanide is very poisonous and very soluble in water. The acute toxicity of most barium salts (except Ba sulfate) is in the low mg/kg LD₅₀. And this toxicity does not even include the free cyanide part of this soluble salt which is even more toxic to both humans and other mammals and even fish. It seems ridiculous to have an industrial site next to a creek with 16% Ba(CN)₂ in its top soil to be declared "clean" based on the proposed SRLs. In addition, it does not make sense to leave a residential soil with 0.7% barium cyanide and not require some remediation. The SRL for this highly acutely toxic chemical in residential soils is 0.77%. Additionally, the SRL for cyanide, free, allows up to 1.4% in non-residential area and 0.13% in residential areas. Cyanide can form a very toxic gas HCN (albeit soluble in water) which has an acute fatal dose LD₅₀ of about 50 mg.

A similar example using a liquid instead of a solid salt is the value for benzoic acid, which allows a pool of benzoic acid (100%) in a non-residential area and up to 24% liquid in a residential area. Even though there is no cancer risk, it would not be physically possible for humans to live in such an environment.

ANALYSIS: Acute toxicity refers to the ability of a substance to cause systemic damage as the result of a single or short-term exposure event. LD₅₀ and LC₅₀ are used to describe acute toxicity. LD₅₀s and LC₅₀s represent doses that are lethal for 50% of the test subjects. These values are available for animals only and are extrapolated to humans.

The Soil Remediation Standards Rule and the SRLs were developed to address chronic toxicity. Chronic toxicity refers to harmful systemic effects produced by long-term, low-level exposure to chemicals. Chronic toxicity is described by a dose-response

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curve in which there is a threshold dose before which no effect is apparent and after which increasing the dose results in increasing effects until a maximum effect is reached. The threshold is the dividing line between the no-effect level and the minimum amount that creates an effect.

The SRLs use the USEPA reference doses (RfDs) to evaluate non-carcinogenic chronic toxicity. The USEPA RfDs have been determined from no-effect levels with margins of safety that accounted for species and exposure extrapolations. The RfDs estimate daily exposure levels for the human population, including sensitive subpopulations, that are likely to be without appreciable risk of harmful effects during a lifetime. RfDs are based on no-observed adverse effects levels (NOAELs) or lowest observed adverse effect levels (LOAELs) obtained from experimental studies. The SRLs for barium cyanide and free cyanide are based on the exposure criteria outlined in the ADHS document entitled "Arizona Soil Remediation Levels" dated January 30, 1997, and the chronic RfDs listed for these chemicals in USEPA Health Effects Assessment Summary Table (HEAST) (1995).

The SRLs are not adjusted for acute toxicity concerns. Many symptoms of chronic exposures to toxicants are slow to develop and are very subtle. There is no direct relationship between the acute and chronic toxicity of a chemical. Acute effects are much more readily apparent and more easily studied. As a result, the Department addresses potential acute exposures to toxicants through its emergency response program. Acute exposures usually occur following a spill or other accidental release. In the event that concentrations remain in the soil which are acutely toxic, a provision has been added to the rule to clarify the Department's existing authority to set more stringent cleanup levels in response to an imminent and substantial endangerment to public health or the environment. In addition, the rule already addresses acute and chronic toxicity of chemicals to ecological receptors as well as impacts to surface water.

RESPONSE: R18-7-202 is revised as follows:

F. Nothing in this Article limits the Department's authority to establish more stringent soil remediation levels in response to:

1. A nuisance.
2. An imminent and substantial endangerment to the public health or the environment.

9. Physical Limitations

ISSUE: The SRLs do not consider relevance or relationship to naturally occurring levels in the soil environment nor the physical and chemical limitations and uniqueness of each chemical. For example, the SRLs allow up to 100% nitrate in the soil. This is physically impossible because nitrate is an anion and requires a counter ion (cation) to exist in a physical state (either solid or liquid). What physical meaning does a non-residential SRL of 1,000,000 mg/kg nitrate have? Although there is no cancer risk with nitrate, does it make sense to have a number (value) with no physical relevance as a cleanup standard? A similar statement can be made for aluminum. The anthracene SRL would allow up to 20% of anthracene in the soil. Anthracene is a viscous liquid and irritating byproduct found in coal tar. About 5-10% of this liquid in soil would render it the consistency of road asphalt.

ANALYSIS: The Department acknowledges that the SRLs do not consider the physical limitations of the chemicals. When the Department originally presented the SRL approach to the Task Force, a ceiling value of 100,000 mg/kg was recommended to prevent soil concentrations in excess of 10%. However, some members of the Task Force commented that this was arbitrary and capricious. In response, the Department eliminated the ceiling limit. As a result, some SRLs are 1,000,000 mg/kg, which equates to pure contaminant. SRLs at this level still are protective of human health under the default exposure conditions.

RESPONSE: No change to the rule.

10. Groundwater and Ecological Impacts

ISSUE: Development of the SRLs should have included an evaluation of the potential for transfer to other important media (water and air) and the potential for deleterious impact to the soil, plant, and water environments.

ANALYSIS: The SRLs only consider human health risk from contact with soils. They do not account for each chemical's ability to leach to groundwater, pose objectionable nuisances, or threaten aquatic systems or wildlife. In order to address these other concerns, the rule includes conditions that must be satisfied when selecting SRLs as remediation levels or provides the Department with the authority to take action. Incorporating these other conditions or limitations into the calculation of the SRLs would have resulted in levels that were extremely conservative to account for the diversity of site conditions. The Department believes that site-specific conditions should be evaluated when assessing a contaminant's ability to pose threats to groundwater or ecosystems.

RESPONSE: No change to the rule.

11. Bioavailability

ISSUE: The issue of bioavailability should have been addressed in developing the SRLs. In many cases, the total metal or total organic content of soils is the important value. In some cases, the total concentrations are actually irrelevant. More important is the content that is biodegradable or bioavailable through microbes, to the food chain, and ultimately to humans.

ANALYSIS: Bioavailability is the ability of a chemical to induce an effect in an organism or become incorporated into its tissue. The bioavailability of a contaminant may be influenced by its chemical species, the soil particle size, the associated soil matrix that affects solubility, the mode of intake into the organism, and the nutritional status of the host organism. The Depart-

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ment recognizes the fact that the total concentration of a contaminant in soil may not be bioavailable at any particular site. A determination of the bioavailability can be made in a site-specific risk assessment. Because the SRLs must apply to a broad range of site conditions, it is not possible to include a site-specific bioavailability factor in the SRLs.

RESPONSE: No change to rule.

12. SRL Default Parameters

ISSUE: One commenter expressed concern that SRLs for volatile contaminants and GPLs are not calculated using the same default values for soil parameters (that is, fraction organic content, soil porosity) and contaminant physical and chemical properties (Henry's Law constant, adsorption coefficient). Consistency among the calculations and recommended defaults would be more defensible. Soil parameters selected should be representative of soils in Arizona, not nationally.

ANALYSIS: In calculating SRLs, soil properties and some contaminant properties are used to calculate the volatilization factor (VF), the saturation concentration (C_{sat}), and the 1% free-phase concentration. The fraction organic carbon and soil porosity values are based on mean values reported for an average loam soil. Contaminant physical-chemical information was obtained from the sources referenced in the Region IX PRG memorandum (USEPA, 1996). A tiered approach was used and measured values were selected over calculated values from the most recent reference.

For the GPL guidance document, the fraction organic carbon and soil porosity values were selected within the range of values derived from limited measurements in the Phoenix and Tucson areas. The contaminant properties (K_{oc} and K_H) listed in the guidance document came from a number of sources that were screened to determine if the reported value would be applicable for this use. The model used to develop the GPLs is restricted in application to organic contaminants in alluvial basin sediments.

The Department acknowledges that the default assumptions used to calculate the SRLs and GPLs are inconsistent. The SRLs will be applied statewide, therefore, they need to be more representative of a broader range of soil characteristics such as those represented in the SRL defaults. Use of the GPL default values for calculation of the SRLs would result in more conservative SRLs than those adopted in this rule. It is believed that the SRL defaults represent conditions that are likely to exist at soil contamination sites throughout Arizona.

RESPONSE: No change to rule.

13. Hazard Index

ISSUE: One commenter expressed concern with setting SRLs for non-carcinogens to meet a Hazard Index (HI) of no more than 1.0. Chemicals in the environment are rarely, if at all, found in pure form. It is more common to find mixtures of chemicals. Cleaning up every contaminant at a site to an HI of 1.0 would be a health threat for sensitive populations at a site. For example, if a site contains 20 or more chemicals and they are cleaned up to meet their respective default standards, the total Hazard Quotient (the sum of all HIs) for the site will certainly exceed the target value of 1.0. This cleanup level would be unacceptable to the Federal government and would probably represent a health risk to current or future occupants of the site.

A case in point can be exemplified by polynuclear aromatic hydrocarbons (PAHs). It has been recently discovered that when animals receive non-carcinogenic PAHs at the same time they are dosed with carcinogenic PAHs, their cancer response is higher than when carcinogenic PAHs are given alone. In essence, there seems to be a synergistic relationship between non-carcinogenic PAHs and carcinogenic PAHs. This synergistic relationship is not limited to PAHs and can appear among several classes of compounds and mixtures.

ANALYSIS: SRLs for individual contaminants that are systemic toxicants are calculated based on a Hazard Quotient (HQ) equal to 1. The HI is the sum of the HQs of the various systemic toxicants present at the site.

The Department recognizes that selection of the SRLs as the remediation standards does not require an evaluation of an HI or total site carcinogenic risk. Many other states and USEPA require this evaluation before pre-determined standards can be selected for a cleanup. The Department believes the conservative assumptions factored into SRL development are protective for sites where SRLs are the remediation standards.

However, risk determined from a site-specific risk assessment must evaluate an HI and a total site carcinogenic risk. USEPA guidance on risk assessments recommends the addition of risks for contaminants with similar health effects and similar toxicity endpoints. For instance, the HQs for systemic toxicants are added to determine the total site risk from systemic toxicants (HI). Carcinogens are added in similar fashion to determine total site cancer risk. There are limited data on synergistic effects of multiple contaminants, therefore, the risk is considered additive only.

RESPONSE: No change to rule.

14. 1% Free-Phase Concentration

ISSUE: A number of comments were received on the Department's recommended approach for calculating SRLs to allow up to 1% of free-phase in the soil. Some commenters requested additional information on the proposal and its impacts. Such a discussion should include noting that using 1% of the pore space is a conservative assumption in the absence of other information. The preamble should also note that other evaluations to assess mobility on a site-specific basis as part of a risk assessment would be considered by the Department. In addition, the reference for the source of the 3-8% pore space discussion should be provided in the preamble and in the technical support documentation from ADHS.

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While the presence of free product within 1% of the pore volume of a typical soil may not result in free product transport, what effect does the additional free product mass have on the rate of movement and contaminant concentrations in soil gas reaching potential receptors at the surface, and is this accounted for by the model?

Some commenters suggested that the studies upon which the approach is based are not infallible. The laboratory studies used glass beads which are all perfect, subsurface soils are not. Also, laboratory studies cannot recreate the possibility of macropores (open voids within soil horizons) that will allow the migration of contaminants to extremely great depths. Plant root systems also can provide a conduit for migration to great depths. The commenters pointed out that a remediating party or ADEQ can never be completely assured that contamination left in place (at the levels that are proposed for some of the volatiles and TPH) will not migrate to groundwater based upon the site investigation, regardless of how well thought out the sampling plan was. Therefore, they do not believe that contaminants should be left in the soil at some of the concentrations proposed in the rule. It was suggested that substance-specific soil saturation constants be incorporated into Appendix A. Additionally, clarification should be provided in both the rule and Preamble when it is appropriate to use soil saturation constants in place of SRLs.

Other commenters stated that the Department's proposed approach was too conservative based on 2 conclusions: 1) exceeding the saturation limit does not increase health risks; and 2) that chemicals remain immobile until the saturation limit is exceeded by 3% to 8%. The commenters stated that basing the SRLs on the saturation limit is arbitrary and does not reflect true health risks. As USEPA admits, at the saturation limit "the emission flux from a chemical reaches a plateau," and "volatile emissions will not increase above this level no matter how much more chemical is added to the soil." As a result, "the inhalation route is not likely to be of concern for those chemicals with SSLs [in this case, SRLs] exceeding" the saturation limits (USEPA, "Soil Screening Guidance: Technical Background Document," (May 1996), (SSL Guidance)). USEPA's conclusion that concentrations above the saturation concentration do not present an additional health risk is supported by the ASTM Standard for Risk-Based Corrective Actions. As the ASTM acknowledges, for toluene, ethylbenzene and xylenes, not even the most stringent risk level based on inhalation would be exceeded "for pure compound present at any concentration."

The commenters referenced the USEPA SSL Guidance that explains the non-carcinogenic risk levels for substances with SRLs set at the saturation limits are far below the hazard index of 1 which is required to be met under the proposed rules. For example, the non-cancer risk (hazard quotient) for ethylbenzene based on the saturation limit would be 0.07. Because setting an SRL at a concentration above the saturation concentration will not increase the health risk through the inhalation pathway (the pathway which presents the greatest risk for the chemicals impacted by the saturation limit as the acceptable risk-based concentrations for soil ingestion far exceed the saturation concentrations), using the saturation concentration to establish a health-based SRL is unnecessary.

Technical studies indicate that the ability of chemicals to mobilize does not occur until they reach a range of 3% to 8% above the saturation limit. Given this range of values, commenters believe the SRLs should be established on the lower end of this range (3%). Using a concentration of 1% above the saturation limit is too conservative, and overestimates the health risks posed by these substances. Consequently, the SRLs should be based on a concentration of 3% above the saturation level, unless the hazard index is exceeded below that concentration. As with benzene, establishing unreasonable SRLs for these non-carcinogenic volatiles (specifically toluene, ethylbenzene, and xylene) will unnecessarily tax the SAF and again create bad public policy.

ANALYSIS: The SRLs for volatile compounds are developed from a model that assumes there is no free-phase contamination present in the soil. The soil saturation concentration (C_{sat}) corresponds to the total contaminant concentration in soil (that is, the total mass of contaminant in all phases within a volume of soil). C_{sat} represents an equilibrium condition in which the pore water is at the solubility limit, the soil gas is saturated with the contaminant, and the soil particle adsorption sites reach their limit. At greater concentrations, the contaminant will form a 4th phase in the soil (free-phase or free product phase) that begins filling the pore spaces between soil particles.

At C_{sat} for a contaminant, the emission flux from soil to air reaches a plateau. Volatile emissions will not increase above this level no matter how much more contaminant is added to the soil. Therefore, C_{sat} values represent chemical-physical limits in soil and are not risk-based. In fact, for some contaminants with SRLs above C_{sat} , the risks are significantly below the specified excess lifetime cancer risk level or a Hazard Quotient of 1 (USEPA, 1996).

For the 19 volatile compounds on the SRL list that are liquid at normal soil temperatures, the saturation limit is lower than the concentration of the contaminant in soil that would be protective of human health. In other words, additional contaminant could be present in the soil in the free-phase without exceeding an acceptable level of risk. Since the risk is already lower than the standardized level of risk for the other SRL compounds, the Department has adopted an alternative method for calculating SRLs for the 19 compounds. This alternative allows a maximum of 1% of the pore volume of the soil to be occupied by free-phase product. Laboratory studies of hydrocarbons indicate that movement of free-phase between pores occurs when 3 to 8% of the pore volume is occupied by the free-phase (Domenico and Schwartz, 1990). Limiting the volume of free-phase to 1% is believed to represent a reasonable approach to developing the SRLs while assuring that free-phase will not move between pores.

The Department recognizes the limitations and uncertainties when relating laboratory responses under controlled conditions to the real world. There are many considerations, such as voids, that could allow migration of free-phase. Therefore, the Department believes limiting the volume of free-phase to 1% of the pore volume is a reasonable approach that should prevent contaminant migration with some margin for error.

Additionally, although volatile emissions plateau above C_{sat} , risk to human health from other exposure routes continues to increase with greater soil concentrations. Therefore, the Department was concerned that acceptable health risk levels could be

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exceeded. To evaluate this possibility, the calculated 1% free-phase concentration was compared to the systemic toxicity value for the individual compound to ensure that the concentration at 1% free-phase did not exceed a health-based value. If the 1% free-phase concentration was greater than the systemic toxicity value for residential or non-residential use, the systemic toxicity value was selected as the SRL. As a result, the residential SRL for 15 of the 19 volatile compounds is based on systemic toxicity, not the 1% free-phase concentration. If the concentration of free-phase is increased to 3% as requested, the systemic toxicity value will cap the SRL for all 19 compounds. Based on this analysis, the Department reiterates its position that the 1% concentration is a reasonable limit on this approach.

Appendix A to the rule incorporates the soil saturation constants in the calculations of the SRLs for the 19 volatile compounds. Additional information on the parameters used to calculate the 1% free-phase concentration is provided in the 2nd document attached to the Preamble.

RESPONSE: No change to the rule.

15. Depth Limits

ISSUE: The proposed rule contained 2 options for depth limits of pre-determined standards. Option 1 set a 4-meter limit for non-volatiles where no remediation would be required past 4-meters unless groundwater would be impacted or 1 of the other conditions would be violated. This option would require volatiles to be remediated to the full depth, just as is currently required. Option 2 set a 4-meter depth for non-volatiles and set a 6-meter depth for volatiles provided groundwater would not be impacted or none of the other conditions would be violated.

The Department received a significant number of comments on the proposed depth limits. Some commenters indicated that the Option 1 is too conservative. They stated that it is highly unlikely that under any type of commercial or residential scenario an individual would be exposed to soils deeper than 1 meter. The commenters stated that remediation to a 4-meter depth is excessive since the protection of groundwater will control the appropriate cleanup level. Remediation to a depth less than 4-meters may be protective of groundwater. In addition, remediation of volatile compounds for the entire vertical extent seems impractical and unnecessary.

Other commenters stated that Option 2 provides adequate protection under most residential, industrial, or excavation worker exposure scenarios because the proposed depth limits are set so deep that they eliminate the surface exposure pathways for both volatiles and non-volatiles. In particular, exposure to volatile compounds at depths greater than 6-meters via inhalation likely would not occur since volatile constituents would not be expected to reach the surface from that depth, especially when a clean layer of soil lies between the contamination and the ground surface. These commenters also indicated that construction activities are unlikely to result in the excavation of material below these depths. Other comments stated that this option is consistent with approaches taken in other states, provides certainty to entities engaged in remediation, and groundwater is protected through the leachability screening requirement. Almost all proponents of depth limits still wanted the ability to conduct a risk assessment to determine site-specific depth limit.

In contrast, others indicated that neither option should be proposed. Several stated that the proposed depth limit options represent an unacceptable compromise to ADEQ's mission statement to "preserve, protect, and enhance the environment and public health." These commenters took the position that it is unclear why anyone should be allowed to leave virtually any concentration of contaminants 1 centimeter below an arbitrary depth. The public would be better served if ADEQ were to simply set conservative pre-determined soil clean-up levels. If a responsible party believes that risk is not present due to depth of the contaminant, then a risk assessment should be conducted that takes into consideration site-specific conditions as well as current and future land use considerations. In short, these commenters believe that a risk assessment is the simplest and most effective means of achieving depth specific cleanup limits.

In addition, allowing unrestricted contaminant concentrations at pre-determined depths does not account for the chemical's mobility and half-life in the environment, its effects in the subsurface ecosystem, and its potential to bioaccumulate. Acceptable depth determinations cannot be set universally for every site. Each site has its unique combination of contaminants and site-specific geological, topographical, hydrogeological and meteorological conditions. Allowing high contaminant concentrations at a uniform depth may be an expensive, overly protective solution for 1 site while unsafe at a 2nd.

Numerous commenters indicated that any scenario in the rule that would allow potentially health-threatening levels of contaminants to remain at depth should provide for adequate notice provisions. They stated that this is important so that interested parties, such as current and future users of the property, as well as adjacent property owners and users of local water resources, could, at their own initiative, locate information about the contamination and determine whether or not current or future land use practices need to be modified to prevent exposure pathways. This is particularly important where there is a potential for excavation of soils, as well as where there may be potential threats to groundwater including installation of dry wells, leach beds, catchment areas, or other sources of infiltration above the contaminated soil. These commenters urged that, at a minimum, any notice that is required by ADEQ should contain very specific information about the location, type, and levels of contamination remaining at depth.

One commenter stated that allowing potentially high levels of contaminants to remain without requiring a VEMUR is illogical and inconsistent with the Legislative intent of providing notice to future site owners to consider the risks that contaminated soil might present to planned land uses. A VEMUR, which goes in the property chain of title, is a far more reliable and long-lasting means of communicating information to future property owners than the Repository. There is no reason to assume that future property owners will be inclined to check the Repository, if it still exists, for information about the property. Therefore, if

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ADEQ elects to approve rules that allow soils contaminated above SRLs to remain at depth without a site-specific risk assessment, a VEMUR or some equally effective notice beyond the Repository should be required.

Other comments indicated that other types of engineering controls require assurances that the engineering control will be maintained to ensure that potential routes of exposure continue to be controlled by the engineering control. There is no such assurance with the depth provisions proposed and no real restrictions against eliminating the protections offered by depth (that is, excavating the area) at some later date. In addition, other comments stated that the options: will create a regulatory loophole that will allow the burying of hazardous wastes; are flawed in their failure to account for commonly accepted engineering and scientific principles governing multi-phase sub-surface fluid flow within a porous media; and failed to account for the underground injection control.

Additional comments were received against individual depth options. Several stated that the depth limits are arbitrary and have no scientific or practical basis. Four meters is common in excavating for swimming pools, commercial buildings, or in some cases residential dwellings with basements. It is a faulty assumption to think that no 1 will excavate to a depth below 4 meters and uncover or move the contamination to the surface. These commenters took the position that no basis for the depth limit of 6-meters for volatiles is provided at all. Without a scientific or logical basis for the selection of this depth limit, Option 2 cannot be supported.

Other commenters indicated that Option 2 appears to allow free-phase material to remain beneath the ground surface at any site regardless of use. This completely ignores the potential for volatilization to the subsurface in coarse-grained sands, gravels or cobbles, where inhalation of the vapors is the primary pathway to receptors. The exposure potential of receptors to volatiles entering subsurface structures is also ignored. This indoor air exposure pathway is considered at this time to present greater risks than exposures to volatile contaminants in outside air. Additionally, volatile compounds left in place beyond the proposed limit would certainly migrate through the soil and the fumes could enter the underground levels of buildings through cracks in the concrete creating a very dangerous and explosive situation. This is currently the case where a parking garage in Phoenix, which extends 4 floors underground (about 40 feet), is being impacted by gasoline fumes from a leaking underground storage tank.

Others stated that although there is little risk to receptors from most non-volatile constituents below a depth of 4 meters, leaving extremely high levels of hydrocarbons (which are non-volatile per the definition), could impact more soil and potentially reach groundwater. The potential for continued migration to groundwater is even higher with volatile constituents such as BTEX, PCE or TCE. The volatile contaminants could be flushed to groundwater by water infiltration through drywells or similar drain type structures. ADEQ should consider potential threats to groundwater, including installation of dry wells, leach beds, catchment areas or other sources of infiltration above the contaminated soil.

Finally, some commenters stated that since the bottom of most large fuel tanks (10,000 gallon capacity) rest at a depth of 12 feet, cleanup would not be required for a leak from a large diesel tank. In addition, there would be no incentive to prevent or report leaks and subsurface releases, other than the cost of the fuel or chemical spilled.

Commenters offered several other options for depth limits. One option excludes the use of depth limits for residential uses. Another recommended that ADEQ adopt something similar to the Massachusetts standard, in which the "look-up tables" of default cleanup standards allow the flexibility to address deep contamination if it presents a health risk, but which also allows for relatively high levels of contamination to remain at depth if there is little reason to believe that the contamination will present a problem in the future.

ANALYSIS: Although the Department acknowledges that the depth limits for pre-determined standards may provide adequate protection under some exposure scenarios, neither depth limit provides the overall protection the pre-determined standards require. Thus, neither option will be adopted at this time. A site-specific risk assessment is the most appropriate means of determining a depth limit. This view was shared by both proponents and opponents of the depth limits. In addition, as several commenters pointed out, a uniform depth limit may be overly protective at 1 site while unsafe at another.

The Department also shares the commenter's concern about public awareness of contaminants at depth. The intent of A.R.S. § 49-152 is to ensure that adequate notice is given to future property owners so they can make appropriate decisions to prevent exposure. However, there is no statutory authority to require a VEMUR if the residential pre-determined standards are met.

Even though the Department is not adopting the depth limits, it does not mean that remediating parties have to conduct a complex risk assessment to determine the depth at which contaminants may be left in place. ADEQ and ADHS have drafted guidance, entitled "Deterministic Risk Assessment Guidance," which includes a section on conducting a simplified risk assessment. The approach uses simplified default equations while still allowing the flexibility to consider site-specific conditions.

RESPONSE: R18-7-204 (now R18-7-205) is revised to delete both options in the proposed R18-7-204(B).

16. Polychlorinated Biphenyls SRL

ISSUE: One commenter stated that R18-7-204(C) is unclear. This section states that a pre-determined standard established by federal law or regulation may be used for PCBs regulated pursuant to the Toxic Substances Control Act (TSCA, 40 CFR 761). The rule needs to clarify whether it is presenting the option of using the established SRL or some other pre-determined standard established by federal law. Further, it is unclear whether these are the only 2 standards applicable for PCBs or whether a risk assessment or site-specific remediation level may also be used.

Another commenter indicated that under TSCA, the federal standard is 1 ppm for residential cleanups and 1-25 ppm for industrial cleanups, as compared to 0.66 ppm (residential) and 3.4 ppm (industrial) under the SRLs. It is important to point out that

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under a CERCLA risk-based approach, the cleanup level would likely result in concentrations that are closer in value to that of the SRL.

In addition, either a period should be placed after "PCBs" or the word "under" should be placed before the CFR citation. 40 CFR 761 is not the Toxic Substances Control Act, therefore, another reference should be used. Also, if the reference to 40 CFR 761 is retained as designating the standard for remediation, shouldn't it be incorporated by reference?

ANALYSIS: The option provided by the proposed rule allowed PCB cleanups to be performed in accordance with federal requirements in 40 CFR 761, Subpart G. This reference to federal standards was provided because Arizona does not have delegated authority for TSCA. The requirements under TSCA apply to PCB spills that occurred after May 4, 1987. USEPA reserves the ability to establish different cleanup requirements for older spills. The TSCA cleanup requirements are not simple pre-determined standards and USEPA can require cleanups to meet more stringent or less stringent requirements at their discretion.

The Letter of Completion issued by the Department can acknowledge only that the remediation levels in this rule have been attained; it cannot provide assurance that USEPA will accept the levels as meeting their requirements. Therefore, the Department is deleting R18-7-204(C) from the rule. The deletion signifies that this rule only applies to remediations conducted under A.R.S. Title 49 authority. The Department is unable to set standards for programs outside our authority (Please see Issue #4 in R18-7-202) or issue letters verifying compliance with USEPA programs.

RESPONSE: Proposed R18-7-204(C) is deleted from the rule.

17. Arsenic SRL

ISSUE: Many comments were received regarding the proposed arsenic SRL of 0.38 mg/kg for residential exposure and 2.4 mg/kg for non-residential exposure. Numerous commenters faulted the Department for proposing levels significantly lower than natural background concentrations of arsenic in Arizona soils. In Table C-2 of the "Guidance Document for Procedures and Methodology for the Determination of Background," produced by the Task Force's Background Working Group (June 18, 1996), of 39 background samples of soil gathered by USGS on a statewide basis, not a single sample was below the 0.38 mg/kg residential cleanup level and only 6 samples met the non-residential standard. The highest arsenic concentration was 97 mg/kg and the average concentration was 9.8 mg/kg. Thus, the average background concentration is approximately 30 times greater than the proposed residential SRL, a clear indication that the proposed SRL for arsenic is inappropriate. Given this fact, parties will be forced to conduct costly background sampling or to perform a risk assessment to establish an appropriate cleanup level for arsenic.

Some commenters indicated that if ADEQ is identifying arsenic at 0.38 mg/kg as the maximum concentration which is safe for residential use, this is saying that it is unsafe for children 1 to 6 years old to live in Arizona or much of the western United States. Despite the elevated natural background, there is no evidence of elevated cancer rates in Arizona, or of the symptoms typically associated with arsenic-induced cancer. This strongly suggests to the commenters that the proposed SRLs are overly conservative.

Other commenters have faulted ADEQ for developing the arsenic SRL using an excess lifetime cancer risk level of 1×10^{-6} (Please see Issue #6). The purpose for enacting the soil remediation statutes in 1995 was to ensure that remedial cleanup levels were established on the basis of sound science for *each level* rather than basing standards on an adherence to a 1 size fits all formula that has questionable validity as applied to particular substances. The commenters believe that the Department has chosen to apply a uniform criterion to setting SRLs for all Class A carcinogens.

Furthermore, commenters indicated that although the PRGs are designed to meet 1×10^{-6} excess risk levels, the conservatism applied in the development of the PRGs may lead to risk levels significantly less than 1×10^{-6} . This appears to be the case with arsenic. For example, the slope factor used to establish the SRL for arsenic in soils is derived from studies in Taiwan that have been challenged as being invalid when applied to conditions in the United States. Specifically, those studies are based on social habits in Taiwan which are inapplicable to the United States. Moreover, those studies specifically focused on the consumption of arsenic in drinking water, not soils, even though arsenic dissolved in water is much more bioavailable than arsenic in soils. In fact, the studies generated a slope factor which is excessively conservative even for drinking water. Therefore, the slope factor used to calculate the SRL for arsenic overestimates the cancer risk from arsenic in soils by at least 2 orders of magnitude.

The uncertainties related to the cancer slope factor for the ingestion of inorganic arsenic were also discussed in a memorandum for USEPA Administrator, Mr. Lee Thomas, in 1988 that explained the recommendations of the Risk Assessment Council. Pertinent portions are quoted as follows:

"... in making case-specific risk management decisions, program offices should be aware of qualities and uncertainties of a carcinogenic risk estimate for ingested inorganic arsenic that might mitigate their concerns compared to estimates of risk for other carcinogens. In the Council's view, these qualities and uncertainties could, in a specific-risk management situation, modify one's concern downwards as much as an order of magnitude."

In addition, a review of the *Toxicological Profile for Arsenic* published in the U.S. Department of Health Services in 1993 provides additional foundation for Administrator Thomas' concern about the overestimation of cancer risk for arsenic. This noted that the USEPA is currently in the process of revising its 1986 *Guidelines for Carcinogen Risk Assessment*. The proposed revisions were submitted for public comment on April 23, 1996, and are currently under review by the Science Advisory Board (SAB). Following incorporation of public comments and the SAB's comments, the draft will be submitted to the Risk Assess-

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ment Forum and then to the USEPA Administrator for approval. Based upon the draft submitted for public comment, it is reasonable to anticipate that implementation of the revised guidelines will result in a significant increase of the concentrations levels equivalent to a 10^{-6} excess risk.

Another problem that commenters identified with the proposed arsenic SRL is that federal and state laws which govern the land application of biosolids (see A.A.C. R18-13-1505) allow significantly higher concentrations of arsenic to be present in the biosolids (Please see Issue #9 in R18-7-202). Thus, the possibility exists that lands on which biosolid application occurs will exceed the SRLs for arsenic, especially the residential SRL. Whether intended or not, the SRL may limit the land application of biosolids and create disposal problems for generators of biosolids that were intended to be alleviated by the biosolids rule. This public policy consequence also supports the Department's serious reevaluation of its arsenic SRLs.

Lastly, 1 commenter indicated that the stringent SRL will require costly cleanups where there is no benefit to human health. For example, at a former smelter site in Montana, USEPA toxicologists found that a safe level of arsenic in the towns where the people were living was 250 milligrams per kilogram of arsenic. They did a tremendous amount of research to arrive at that number, even including going into the towns and taking samples from the people and hiring independent researchers at universities to validate what they found. Under Arizona's Soil Remediation Standards Rule as written, the best available science could not be used even if it was justified.

The Department received several recommendations for modifying the proposed arsenic SRL. One commenter stated that the Department could choose to establish the arsenic SRL based on the average background concentrations of arsenic in the state. This would result in a residential SRL of approximately 10 mg/kg and a non-residential SRL of approximately 60 mg/kg based on the ratio between the proposed non-residential and residential SRLs for arsenic.

Another commenter recommended that the residential SRL be set at 30 mg/kg, a value equal to the 90th Upper Tolerance Limit for background concentrations of arsenic in Arizona. The Tolerance Limit is 1 of the statistics recommended by the USEPA for determining when concentrations of chemicals in soil exceed the background concentrations (USEPA, 230/02-89-042 "Methods for Evaluating the Attainment of Cleanup Standards, February, 1989). The 90th percentile Upper Tolerance Limit was calculated using the soil sample results presented in the "Evaluation of Background Metals Concentrations in Arizona Soils" prepared for ADEQ in 1991. There are 66 soil sample results for arsenic, 27 samples collected by ADEQ and 39 samples collected by the United States Geological Society (USGS). The objective of the report was to determine background concentrations of metals for risk assessment purposes. This is a substantial number of sample results and should be adequate to set a background SRL.

One other commenter recommended setting the residential SRL for arsenic at 41 mg/kg and the non-residential SRL at 240 mg/kg to be consistent with the requirements for the Monthly Average Pollutant Concentration for Composite Biosolids application. Currently, these are the allowable concentrations for application of biosolids.

Others recommended methods of establishing an arsenic SRL including basing it on: a 1×10^{-4} excess cancer risk that would deem most uncontaminated soils to be relatively safe and would allow for some accumulation of arsenic in soils where biosolids are applied; the bioavailability of the arsenic; non-carcinogenic impacts; ensuring that receptors are not exposed to a quantity of inorganic arsenic greater than some level (5% for example) above the average daily dietary intake; and deferring rulemaking for arsenic.

ANALYSIS: The Department recognizes that some naturally occurring concentrations of arsenic in Arizona are higher than the proposed SRLs. When the Final Soil Remediation Standards Rule was proposed, it was expected that the majority of remediations where arsenic is a contaminant of concern would opt for the background level approach. It was believed that this standard would force many remediating persons to undertake a costly demonstration of the naturally occurring background arsenic level.

The Department would like to point out that the only sites that should analyze soil samples for arsenic are those where arsenic was suspected or known to have been released. In light of this, the scope of the problem is likely much smaller than actually exists. However, the Department acknowledges that if soil samples are analyzed for arsenic, many of the issues identified in the comments remain.

In regard to the risk management decision to develop the arsenic SRLs based on 1×10^{-6} , the SRLs were developed using a consistent methodology based solely on risk to human health without consideration of other factors (Please see Issue #6). In addition, the Director decided to calculate Class A carcinogens based on an ELCR of 1×10^{-6} . However, the Department recognizes that there is considerable uncertainty and ongoing debate about USEPA's arsenic slope factor.

As a result of the problems associated with the natural background of arsenic as well as the uncertainties associated with the arsenic slope factor, the Department has modified the arsenic SRL. The residential and non-residential SRLs are adopted at 10 mg/kg based on the average naturally occurring background concentration of arsenic in Arizona soils. The average background concentration is obtained from sampling data from the USGS (Boerngen and Shacklette, 1981). The USGS took samples in several locations throughout Arizona at constant depths. Only 1 number for both residential and non-residential exposure scenarios is adopted because natural background is not based on land use.

The Department evaluated the recommendation to set the arsenic SRL at 30 mg/kg and believes that this is inappropriate. The 95th upper tolerance limit should be used to determine background concentrations for a site. This is not a good representation of natural arsenic levels throughout Arizona.

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The Department also evaluated the recommendation to base the arsenic SRL on the biosolid cumulative loading levels (Please see Issues #9 and #10 in R18-7-202). The cumulative pollutant loading rate for arsenic in sludge is 41.0 kg/hectare. In order to determine the concentration in soil, the units must be translated to mg/kg by making some assumptions about the depth of the application (6 inches) and the weight of a hectare of soil (2.2 million kilograms). This equates to a maximum allowable lifetime concentration in soil of 18.6 mg/kg.

Generally, concentrations of arsenic in biosolids reported to the Department are low, rarely exceeding 10 mg/kg. Land application of biosolids to agricultural lands most likely will not exceed the residential standard (Please see Issue #9 in R18-7-202 for more discussion). However, if a farmer intends to change the future use of land to a residential use, there is the potential to exceed the residential SRL if biosolids are applied for the maximum period of time, at the maximum annual concentration, and to a minimum depth of 6 inches. The Department feels it is unlikely that all these conditions will exist at any 1 location.

In regard to the other recommendations, either very little information is available or the method suggested is not scientifically defensible. Deferring the arsenic standard for another rulemaking also is not viable because the purpose of this rulemaking is to set soil remediation standards for all contaminants. It is also unknown when USEPA issues regarding the arsenic slope factor will be resolved.

RESPONSE: The residential and non-residential arsenic SRLs are revised to 10 mg/kg.

18. Benzene SRL

ISSUE: The proposed SRL for benzene reduces the residential cleanup level from the existing HBGL of 47 mg/kg to 0.62 mg/kg, an almost 100 fold decrease. This decrease is due, in part, to the fact that the SRL is based on the erroneous assumption that exposure to the benzene, primarily through inhalation, will occur throughout a 30-year period, even though it is likely that the benzene will degrade or volatilize long before 30 years elapse and will never reach a receptor at the surface. The result is a proposed residential SRL for benzene that is more stringent than the calculated minimum groundwater protection level (GPL) for benzene of 0.71 mg/kg. (The GPL is based on the assumption that benzene contaminated soils are present at the soil/groundwater interface). In other words, a party could be required to remediate benzene-contaminated soils at any depth, even though this cleanup would not be necessary to protect groundwater. This fact, combined with the fact that it is inconceivable that such a small concentration of benzene would cause an inhalation exposure at the ground surface, makes the proposed SRL unnecessary for public health protection purposes.

ANALYSIS: The SRLs for benzene are more stringent than the HBGLs because the inhalation exposure route is included in calculating the SRLs. The inhalation route of exposure poses the greatest risk for adverse health effects from benzene. Additionally, benzene is a known human carcinogen. SRLs for known human carcinogens are calculated at a excess lifetime cancer risk of 1×10^{-6} . Residential SRLs for carcinogens, including benzene, are calculated using a 30 year exposure period.

The model used to quantify flux for the inhalation exposure estimate (Jury model) assumes that the concentration of contaminant in soil at year 30 will be 0 mg/kg, with the contaminant lost through flux over the exposure interval. The emission flux follows a lognormal distribution, resulting in a rapid decrease in soil contaminant concentrations over time. This decrease in flux over time is taken into account in the inhalation exposure equation such that inhalation exposure concentrations in the final years of the 30-year exposure period are negligible.

The Department acknowledges that the SRLs are conservative values for soil cleanups. However, developing "off-the-shelf" standards that can apply to a wide variety of sites under a range of site conditions required conservative assumptions. If the default assumptions in the SRLs calculations do not apply to a particular site, the remediating party may choose to conduct a site-specific risk assessment. All parties may choose to calculate alternative cleanup standards that account for site-specific conditions including the depth and mass limits of the contamination.

It should be noted that the UST Suggested Soil Cleanup Levels (SSCLs) for benzene before the Interim Soil Remediation Standards Rule was 0.13 mg/kg. Add the fact that groundwater considerations rarely allow benzene soil concentrations to remain at 47 mg/kg and the net change is very small.

In addition, comparison of the SRL to the GPL is not appropriate because they are calculated to evaluate the impact of contaminants on different receptors, human health and groundwater, respectively. The SRLs are calculated using a human health-based approach that is generally consistent with risk assessment methodologies recommended by the USEPA and the ADHS.

RESPONSE: No change to the rule.

19. Lead SRL

ISSUE: No discussion is provided regarding the calculation of the SRLs for lead (Pb). If any other SRLs are calculated differently, the difference should be noted, explained, and a reference provided to discuss the variable calculation.

ANALYSIS: The SRLs for lead and arsenic are calculated using a different methodology from that detailed in the 2nd document attached to the Preamble. (See issue #17 for discussion of arsenic SRLs). Since the USEPA has not published a reference dose or slope factor for lead, the SRL for this compound has been developed using USEPA's Lead Integrated Exposure Uptake/Biokinetic (IEUBK) Model (USEPA, 1994). The IEUBK model generates a probability distribution of blood lead levels for a population of children exposed to lead in a number of media. The distribution reflects the variability of blood lead levels in several communities. Lead exposures integrated in the model include dietary sources, drinking water, air, soil and household dust, and other sources. SRLs were generated assuming default assumptions for all media.

The SRLs for lead are designed to limit the percentage of children with blood lead levels in excess of 10 micrograms/deciliter ($\mu\text{g/dL}$) to 5% based upon recommendations by the USEPA and the United States Center for Disease Control and Prevention (CDC). The residential SRL of 400 mg/kg represents a concentration of lead in soil that would be expected to limit to 5% the percentage of children with blood lead levels greater than the reportable limit of 10 $\mu\text{g/dL}$. The non-residential SRL of 2,000 mg/kg represents a concentration of lead in soil that would be expected to limit to 5% the percentage of babies born with blood lead levels greater than 10 $\mu\text{g/dL}$ in a maternal population with occupational exposure.

RESPONSE: No change to rule.

20. Hydrocarbon SRL

ISSUE: The Department received several comments on the proposed SRL for petroleum hydrocarbons that have 9 or more carbon atoms. Some commenters were unclear as to what cleanup levels should be used for TPH compounds with chains below C_9 . Others indicated that the use of Diesel Fuel No. 2 as a surrogate to determine slope factors and toxicity of petroleum products may not be appropriate. A significant percentage (if not a majority) of petroleum product releases are composed of gasoline. As a result, BTEX compounds likely contribute the predominant relative risk in the majority of petroleum hydrocarbon spills. Considering that the more toxic petroleum compounds are generally in the lower carbon range and the use of Diesel Fuel No. 2 incorporates only a small portion of the lower gasoline range, the use of Diesel Fuel No. 2 may not be a conservative approach to deriving SRLs protective of human health and the environment.

Another commenter stated that the use of the slope factor from Millner et al., 1992 to develop the SRL for C_9 + hydrocarbons is inappropriate considering the methods being used or proposed to be used by other states and groups studying this issue. The validity of this slope factor is in question since: USEPA has not approved the slope factor; the slope factor has not been published in a peer reviewed toxicological journal; and numerous states and groups (that is, Massachusetts, TPH Criteria Working Group) studying the issue are not using or recommending the slope factor to be used. The slope factor for C_9 + hydrocarbons was developed for hydrocarbons in the range C_9 - C_{15} . The toxicological differences between C_9 - C_{15} hydrocarbons and C_{20} + hydrocarbons should not be ignored. Although for some releases or some portions of some releases the C_9 + hydrocarbon SRL is appropriate, for others such as used oil or a C_{20} + aliphatic hydrocarbon mixture, the cleanup numbers are overly conservative.

Other commenters indicated that the proposed residential level of 4,100 mg/kg and the proposed non-residential level of 18,000 mg/kg are too high. These levels only consider long-term, chronic health risks. They do not consider short-term human health effects, acute effects, nor nuisance effects (such as a sickening odor). An offensive odor is commonly given off by soil with TPH concentrations of 200 mg/kg. In addition, extremely high cleanup levels, such as those proposed, could easily leach into groundwater posing a more serious threat to human health and the environment. It is possible for fuel to float on groundwater due to soil contamination as low as 2,000 mg/kg.

In addition, 1 commenter stated that hydrocarbons chains of C_9 and above incorporate both gasoline range hydrocarbons (C_9 to C_{12}) and heavier-end diesel range hydrocarbons (C_{12} and greater). USEPA Method modified 8015 would be the only analytical method available to analyze for both of the hydrocarbon ranges. The USEPA modified 8015 analytical method requires 2 separate analytical processes to quantify both of the ADEQ specified hydrocarbon chain groupings. These processes include use of a photo-ionizing detector for the volatile gasoline ranges (C_9 to C_{12}) and a flame-ionizing detector process for the heavier-end diesel range hydrocarbons (C_{12} and greater). Use of 2 methods will create additional cleanup costs and increase the time needed for the laboratory to complete the analysis.

The Department also received several recommendations for developing an SRL for hydrocarbons. One recommended that ADEQ adopt different SRLs based on different carbon chains using surrogates for each range. For example, Massachusetts has utilized an approach looking at many chain lengths including C_5 to C_8 , C_9 to C_{18} , and C_{19} to C_{32} . Toxicity values for these constituents were developed and cleanup goals established using n-hexane, n-nonane, and eicosane as surrogates for C_5 to C_8 , C_9 to C_{18} , and C_{19} to C_{32} , respectively. If the hydrocarbon SRL remains as is, the preamble should note that other means of evaluating the toxicity of hydrocarbon mixtures would be accepted by the Department in a site-specific risk assessment.

Another commenter recommended that the past TPH cleanup level of 100 ppm should be seriously considered for the constituent soil remediation level. This is an easily attainable level through current remedial technologies.

ANALYSIS: When the Department proposed the new hydrocarbon SRL, it was anticipated that a new analytical method would be required. As a result, ADEQ requested ADHS develop a method for the hydrocarbon SRL. As a result, ADHS has developed a new method; 8015AZ. However, they informed ADEQ that it would be necessary to adjust the proposed hydrocarbon designation. Method 8015AZ has the capability to quantitate total hydrocarbon concentrations within the range from C_6 to C_{32} . Also, specific ranges from C_6 to C_{10} , C_{10} to C_{22} , and C_{22} to C_{32} can be quantitated. As a result, the hydrocarbon SRL is now designated as "hydrocarbons C_{10} to C_{32} ." Redefining the hydrocarbon range has eliminated the need to perform 2 separate analyses to quantitate the separate hydrocarbon chain groupings.

The hydrocarbon C_{10} to C_{32} SRL is intended to apply to a gross concentration of petroleum hydrocarbons within the range. However, if an individual SRL has been determined for a hydrocarbon (such as benzo(a)pyrene), the individual SRL must be used. Any hydrocarbons with less than 10 hydrocarbons must also use the individual SRL. This means that a gasoline release must be remediated to the individual SRLs for all the BTEX contaminants.

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The Department recognizes that the slope factor used to develop this SRL has not been approved by the USEPA or other states. However, USEPA does not have a published slope factor nor does the TPH Working Group. The Department also acknowledges that the SRL may be conservative for hydrocarbons chains with more than 22 carbon atoms. The SRLs are intended to represent conservative default standards. A remediating party may conduct a site-specific risk assessment to determine a remediation level for any hydrocarbon mixtures if other toxicity information is appropriate.

In regard to the protectiveness of the proposed SRLs, none of the SRLs consider acute effects (Please see Issue #8) or nuisance (Please see Issue #12 in R18-7-201). If hydrocarbons or any other contaminant leaches to the aquifer and impairs the use, the Department can require a mitigation response (Please see Issue #6 in R18-7-203).

The Department evaluated the recommendation to base the hydrocarbon SRL on the Massachusetts approach. This approach was not proposed because several of the surrogates have low saturation limits which, when applied to the SRL methodology, resulted in inappropriately low cleanup levels.

RESPONSE: The chemical name for the hydrocarbon SRL is revised to "hydrocarbons C₁₀ to C₃₂."

21. Residential Cleanups

ISSUE: Currently accepted risk assessment guidance generally requires that reasonably foreseeable uses be considered in setting site-specific risk-based standards. Under the Rule, this does not appear to be a requirement when selecting an appropriate SRL. Some inconsistency between the SRLs and site-specific risk applications is probably appropriate, given the conservative assumptions used to develop SRLs. However, when future change from non-residential use to residential use is imminent or clearly apparent, the more restrictive residential SRL should be applied. Examples of clear and apparent imminent future changes in use might include the filing of a development plan with a local government agency, a rezoning application, an application for building permits, or other publicly available information that suggests a future change in exposure to soils at the site.

In addition, the term "current use" should be defined to specify the point in time relative to the remediation process that the use determination must be made, and to incorporate consideration of imminent or clearly apparent future uses. It is unclear whether the current use is set at the time of the release of a contaminant, the date of discovery of contamination, the date of an Initial Notice, or the date when remediation is complete. Uses can change between any 2 of these dates. As a practical illustration, consider a site being redeveloped at the time a need for remediation is discovered. Without further definition, someone could argue that workers at the unpaved construction site were in "frequent and repeated contact" with the soil, and thus residential SRLs should apply, even though the project under construction was a multilevel office building without any exposed soil to be left on the property. By defining current use to include the imminent or clearly apparent future use, some of these complexities created by the rule would be avoided.

Furthermore, the need to honor local zoning decisions should be further specified. Additional flexibility as to the "current residential use" provisions should also be provided. The following language is recommended:

- D. A person conducting an SRL-based remediation shall remediate to the residential SRL on any property where there is currently a residential use or on any property zoned for residential use in the current master plan of the local zoning authority. Notwithstanding the provisions of this subsection, a person may remediate to the non-residential SRL if the local zoning authority agrees to such alternative remediation level in writing.

ANALYSIS: The language in proposed rule at R18-7-204(D) was intended to ensure that property that meets the definition of residential use is remediated to the residential SRL. This is only appropriate for the use of the property after remediation. A requirement to remediate based on any other date does not allow the owner the choice to remediate to a use appropriate for the intended purpose. The language in these sections will be revised to reflect the post-remediation date. In doing so, the Department does not believe the term needs to be defined.

Although the Department agrees that property should be remediated to the residential SRL if it is likely that the property will be used for residential purposes, the addition of zoning language as recommended is problematic. For example, several zoning classifications include mixed uses. This type of zoning allows both residential and light commercial, such as strip malls or gas stations. It is unclear what standard applies in this type of situation. In addition, every city has different types of zoning classifications.

The Department also believes that additional requirements to remediate to the residential SRL are not needed. If property is not remediated to the residential SRL, a VEMUR must be placed on the property and the owner must restrict the property to non-residential uses. If the use of the property will be changing in the near future to residential, the owner should ensure that the property is remediated to the residential SRL. Likewise, if the property is zoned for residential uses only, the owner should remediate to the residential SRL. Otherwise, the property cannot be used by the owner since it is not zoned for non-residential purposes. Furthermore, the cities should check the title of the property or the Departmental Repository when issuing building permits and rezoning applications (Please see Issue #18 in R18-7-207).

RESPONSE: R18-7-205 is revised as follows:

- B. A person who conducts an SRL-based remediation shall remediate to the residential SRL on any property where there is residential use at the time remediation is completed.

22. VEMURs

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ISSUE: The provision for VEMUR filing on remediations to non-residential levels should appear in R18-7-206 instead of the sections on standards. This would place the applicability of the VEMUR in subsection (A) of the Section addressing that subject. Also, the content of the sections dealing with remediation standards would not deviate from that subject.

ANALYSIS: The Department agrees. R18-7-204(E) has been deleted and R18-7-207 will be revised (Please see Issue #9 in R18-7-206 for revised rule text).

RESPONSE: R18-7-204(E) is deleted.

23. Update of SRLs

ISSUE: What is the purpose of reviewing the SRLs every 3 years? The Department should review new toxicological information as it becomes available and amend the rules at that time. If the requirement to review SRLs every 3 years is left in, it should have a trigger date; "... 3 years from the effective date of this rule...."

ANALYSIS: The Department agrees that it should review new toxicological information as it becomes available. Regardless of the timeframe in the rule, the Department may amend the rule if the toxicological data support that decision. Therefore, the provision for a 3 year review is deleted.

RESPONSE: R18-7-204(F) is deleted.

R18-7-205. SITE-SPECIFIC REMEDIATION STANDARDS

1. Risk Assessment Terminology

ISSUE: Is the term "site-specific risk assessment" the same as "human health risk assessment"? If so, delete 1. If not, define both.

ANALYSIS: The terms have the same meaning. However, site-specific modifies the term "human health risk assessment." Therefore, the term "site-specific" will be added to the term "human health risk assessment" throughout the rule.

RESPONSE: R18-7-201, R18-7-206(A), and R18-7-206(B), are revised to conform to the term "site-specific human health risk assessment."

2. Background

ISSUE: The factors listed to establish background levels as the cleanup standards are unnecessary. The final rule should not require that "migration potential" be considered because that factor is irrelevant to establishing background levels. Similarly, the need to determine the "bioavailability" of the background and site-specific contaminant is a costly undertaking whose value is unclear. If the bioavailability of the site-specific arsenic (for example) is lower than that of the background arsenic, does that mean that a higher cleanup level is allowed? Given these ambiguities, these 2 factors should be eliminated.

Moreover, the requirement that "site-specific sampling of unaffected soils" be performed is problematic. Background should be based on area-specific sampling, not only on site-specific sampling, especially if the site is small. Similarly, the term "unaffected soils" is ambiguous and should be replaced by the phrase "soils not impacted by operations on the site."

ANALYSIS: The Department agrees that migration potential and bioavailability are not needed to establish background concentrations. As such, they will be deleted from the rule. However, background sampling must occur at the site or as close as possible to the site to obtain samples that are representative of site soil conditions. The Department is currently developing guidance to assist in the determination of background concentrations. In addition, the phrase "unaffected soils" is appropriate because anthropogenic sources are not allowed to be used in determining background (Please see Issue # 1 in R18-7-201).

RESPONSE: R18-7-204(B) is revised as follows:

- B. A person who conducts a remediation to a background concentration for a contaminant shall establish the background concentration using all of the following factors:
 - 1. Site-specific historical information concerning land use.
 - 2. Site-specific sampling of soils unaffected by a release, but having characteristics similar to those of the soils affected by the release.
 - 3. A statistical analysis of the background concentrations using the 95th percentile upper confidence limit.

3. Risk Assessments for Groundwater

ISSUE: Will risk assessments be an option for sites with contaminated soil that has impacted groundwater?

ANALYSIS: This rule only applies to soil contamination. Risk assessments can be used to determine site-specific remediation levels for soil. It should be noted that if these levels are not protective of groundwater quality, more stringent levels will be required.

RESPONSE: No change to the rule.

4. Default Parameters

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ISSUE: A specific statement should be included in the Concise Explanatory Statement or Response to Comments in the final rule package that would make 2 points absolutely clear: 1) In performing a site-specific risk assessment, a party is under no obligation to use the input parameters used to calculate the SRLs but can use any input parameters for which the party can provide adequate technical support; and 2) A properly conducted, site-specific risk assessment could result in concentrations of a pollutant of concern remaining in the soil after remediation that are significantly higher than the SRLs for that pollutant.

ANALYSIS: When performing a site-specific risk assessment, a party is under no obligation to use exposure factors or the input parameters used to calculate the SRLs. However, any exposure assumptions or other input parameters must be based upon peer-reviewed literature sources. At a minimum, all deterministic risk assessments must use reasonable maximum exposure assumptions for future use scenarios (Please see Issue # 9). In addition, all risk assessments must use toxicity factors (reference doses and cancer slope factors) established by the EPA. In some cases, a properly conducted, site-specific risk assessment could result in concentrations of a contaminant of concern remaining in the soil after remediation that are higher than the SRLs for that contaminant.

RESPONSE: No change to the rule.

5. Criteria to Evaluate Risk Assessment

ISSUE: The standards and criteria that ADEQ will apply when evaluating a risk assessment report need to be stated in the Rule. Without reference to such criteria, it appears that ADEQ must accept any document purporting to be a risk assessment, as long as it is either deterministic or probabilistic, without considering whether it is complete and meets the current scientifically defensible standards. The Rule should reference specific criteria or guidance that ADEQ will use to critique risk assessment reports.

ANALYSIS: R18-7-205 (now R18-7-206) indicates that a person must remediate to either the residential or non-residential site-specific remediation level. Both of these levels are defined in R18-7-201 to include minimum standards. R18-7-206 also indicates that a person shall use a deterministic or probabilistic methodology or an alternative methodology commonly accepted in the scientific community. These methodologies and the term "human health site-specific risk assessment" are defined in R18-7-201.

Although the rule provides little criteria to evaluate risk assessments, ADEQ and ADHS have developed guidance to assist in the preparation and evaluation of risk assessments. Draft risk assessment guidance for developing deterministic risk assessments was revised in May 1997 and comments have been solicited. The final guidance document is anticipated to be completed by the effective date of this rule. In addition, the USEPA has guidance entitled "Risk Assessment Guidance for Superfund" (RAGS) which has been recommended by ADHS for years. Furthermore, the Department plans to develop a probabilistic risk assessment guidance document before June 1998.

It is the position of the Department that all risk assessments used to make risk management decisions must use a scientifically defensible approach that is generally accepted within the scientific community. Remediating parties are not required to use the guidance, however, any deviations from USEPA and ADHS risk assessment guidance must be well referenced and be based upon peer-reviewed literature sources that can be reproduced. In addition, the Department cannot reference any "guidance" in the rule because it is not legally binding. Other methodologies, input parameters, etc., can be used as long as they are based on peer-reviewed literature sources that can be reproduced.

RESPONSE: No change to the rule.

6. Cost-Effectiveness

ISSUE: The final rules must acknowledge that the Department is required by statute to consider other factors when determining whether a soil remediation level chosen through a risk assessment is in compliance with the applicable statute. For example, A.R.S. § 49-282(E) specifies 3 general criteria for assessing remedial actions under WQARF. While the requirement relating to the protection of public health and the environment are central to the provisions of the proposed rule, the criteria relating to practicability, necessity, reasonableness, cost-effectiveness and technical feasibility embodied in WQARF are not present in the proposed rule. As discussed above, these factors provide a risk management and remedy selection component which must be considered by the Department.

ANALYSIS: This rule applies to all soil remediation programs at ADEQ. Therefore, it is inappropriate to specify what criteria should be used to evaluate WQARF remedy selection. In addition, the definition of residential and non-residential site-specific levels allow the Department to consider risks within the range specified and R18-7-206(E) specifies the factors that will be used to select the appropriate risk level. For WQARF remediations, the evaluation of the appropriate risk within the range may include the factors listed above.

RESPONSE: Please see Issue #11 in R18-7-201 for revisions to the rule.

7. Risk Management Issues

ISSUE: ADEQ cannot implement an effective risk-based rule without establishing a definitive and consistent risk management framework including, at a minimum: 1) Identification of specific risk management decision criteria and a consistent methodology for their application; and 2) Implementation of risk management training programs for agency decision-makers. Universal risk management decision criteria should be established by the agency so that: 1) Risk managers are consistent in how the risk assessment is used in the decision making process; and 2) Risk assessments provide the appropriate information to the risk manager. For example, if weight-of-evidence for toxicity is identified as a factor considered in the risk management process, then

specifications as to the particular components of a weight-of-evidence analysis to be included in the risk assessment should be provided in the risk assessment guidance. As another example, if uncertainty in the risk estimates is to be a factor in risk management decisions, then information such as identification of "risk-driving" input parameters (for example, assumptions or models) or differences in central tendency versus reasonable maximum exposure should be required in the risk assessment and specified in the risk assessment guidance.

A thorough understanding of the risk assessment process and of the specific analytical methodologies used in the derivation of the risk characterization for a particular site is critical for meaningful application of risk assessment results in risk management decision-making. It is recommended that individuals responsible for making risk management decisions be trained in risk assessment methodologies. It is also recommended that some sort of "peer review" program be established within the agency (or between ADEQ and ADHS) to ensure that appropriate actions are identified for chemical release sites.

ANALYSIS: The Department agrees that additional risk management decision criteria should be established. As a result, ADEQ and ADHS have developed guidance to assist in the preparation and evaluation of risk assessments. Draft risk assessment guidance for developing deterministic risk assessments was revised in May 1997, and comments have been solicited. The final guidance document is anticipated to be completed by the effective date of this rule and will include additional information on decision making. Furthermore, the Department plans to develop a probabilistic risk assessment guidance document before June 1998.

The Department also agrees that training in risk assessment methodologies is essential to the consistent application of risk management decisions. Therefore, the Department is seeking training from a number of sources, including the USEPA, ADHS, and contractors. ADEQ expects to have essential risk management staff trained by the time the Final Rule is effective. In addition, the Department is developing a policy which outlines the appropriate roles and responsibilities of project managers and risk assessors.

RESPONSE: No change to the rule.

8. Site Characterization

ISSUE: One commenter stated that more specific guidance should be provided to risk assessors regarding agency requirements for "adequate" data for risk assessments. It is important that ADEQ recognize the data quality objective process and its role in establishing scientifically defensible, cost-effective characterization of site-related and background chemical distributions for risk assessments. These issues were discussed extensively by technical members in the Background Subcommittee of the Soil Cleanup Standards/Policy Task Force, who presented scientifically appropriate recommendations to ADEQ.

It is recommended that ADEQ revisit the discussions/recommendations provided in the Background Subcommittee regarding the determination of "data adequacy" and characterization as it relates to risk assessment and remedial action. USEPA has completed extensive analyses on the topics. Additionally, other experts have published methodologies consistent with USEPA guidance (Neptune and Company, Inc., personal communication; Pesin and others, 1996) which are specifically identified for risk assessment applications.

Another commenter indicated that R18-7-205(C)(1) does not specify how contamination levels will be determined. Should a media maximum or a spatial average be used? In addition, should average concentrations be calculated for a particular time frame, or should the risk be integrated over the actual duration of exposure? The use of initial media maximum concentrations per the proposed final rule is not recommended because it will result in the predetermined SRLs. The lack of a specific method for determining contamination levels may result in inconsistency in risk level interpretations.

ANALYSIS: Site characterization is not addressed in this rule. The determination of extent of characterization is program specific. The Department is currently developing agency-wide guidance on site characterization. This will include a discussion on data quality objectives and should be completed by the effective date of this rule. In addition, ADEQ and ADHS have developed draft risk assessment guidance for developing deterministic risk assessments which provides information on the amount of samples needed to properly evaluate risk assessments.

RESPONSE: No change to the rule.

9. Future Use Assumptions

ISSUE: The Department received several comments that the provision which requires default assumptions to be used for future use scenarios undermines the intent of conducting site-specific risk assessments. The commenters stated that it is more appropriate to assume exposure durations and frequency of exposure may vary according to site-specific conditions. The use of the default exposure frequency (350 days per year) and duration (30 years) will prevent relatively accurate estimations of exposure and risk and will result in some LUST cases not achieving closure or being closed with a VEMUR. This provision should be deleted and should be addressed in the risk assessment guidance to be issued by the Department.

One commenter expressed concern that, although the proposed language may reflect EPA risk assessment guidance, it may improperly drive the choice of the cleanup level. If this provision is included, the rules should state explicitly that the future use analysis will only be 1 factor considered in determining an appropriate risk assessment-based cleanup level.

Another argued that this requirement places an undue constraint on deterministic methodologies that is not placed on probabilistic methodologies. Because of this constraint, there may be a greater tendency to use the less mature and less standardized probabilistic methods. If default assumptions are required for residential future use scenarios when using deterministic

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methodologies, then default assumptions should be required for residential future use scenarios when using probabilistic methodologies. Otherwise, probabilistic methodologies should not be used to meet residential standards.

In contrast, 1 commenter believes that this provision is a reasonable requirement for sites where future land use is unknown. However, this is not appropriate for sites where the future land use is known with certainty.

Lastly, the meaning of "future use scenarios" was unclear to a commenter. Are risk assessments required for past or current use scenarios? If the language means that the default exposure factors shall be used for risk assessments at sites where future land uses may differ from current ones, does the proposed rule also imply site-specific exposure factors are to be used for risk assessments conducted at sites where land use will not be changed? If the answer to the latter question is yes, then why should a change in land uses cause changes in the way the risk is assessed (use of default vs. site specific exposure factors)?

ANALYSIS: Risk assessments evaluate the current use of the property as well as the future use. Site-specific exposure factors are appropriate to be used for current uses. However, due to the fact that the future use of the property is rarely certain, the Department added the condition that default exposure assumptions had to be used. For example, if the intended purpose of the land is residential, then default residential exposure assumptions had to be used. Depending on the current use of the property, it is possible for the future use to drive the cleanup level. ADEQ cannot meet its statutory obligation of protecting human health and the environment if it knowingly permits a situation to develop where contamination is remediated to non-residential standards and yet there is frequent and repeated contact with the soil.

However, the Department agrees that the default assumptions may not always be appropriate to determine future use exposure. For those receptors potentially exposed in the future, the reasonable maximum exposure (RME) must be evaluated in deterministic risk assessments. RME is defined as the highest exposure that may reasonably be expected to occur at the site. The intent of the RME is to estimate a conservative exposure case (that is, greater than the average case) that is still within the range of possible exposures. Similarly, probabilistic risk assessments must provide estimates of reasonable maximum risk that may be expected at the site, with the reasonable maximum risk at the site defined as the 95% upper confidence limit of distribution of risk estimates. Estimates of RMEs are discussed in the Department's deterministic risk assessment guidance.

While EPA standard default exposure factors may be considered RME assumptions, a party is free to research exposure distributions in populations that reflect the future use of their site and determine alternative RME assumptions. It should be noted that the alternative exposure data used in the risk assessment must be supported by peer-reviewed literature that is generally accepted in the scientific community.

RESPONSE: R18-7-201 is revised as follows:

"Reasonable Maximum Exposure" or "RME" means the highest human exposure case that is greater than the average, but is still within the range of possible exposures to humans at a site.

In addition, R18-7-206(B) is revised as follows:

1. A deterministic methodology. If a deterministic methodology is used, reasonable maximum exposures shall be evaluated for future use scenarios.

10. Alternative Methodologies

ISSUE: What are the standards to determine whether a particular alternative methodology is accepted in the scientific community?

ANALYSIS: An alternative methodology is considered accepted in the scientific community if it was based on peer-reviewed literature, such as a professional journal or publication of standards of general circulation. The results published in the literature must be independently evaluated by other scientists in the field. When the results meet with general consensus (that is, academia, public health and environmental agencies, and consultants), the approach may be considered commonly accepted in the scientific community.

RESPONSE: R18-7-206(B) is revised as follows:

3. An alternative methodology commonly accepted in the scientific community. An alternative methodology is considered accepted in the scientific community if it is published in peer-reviewed literature, such as a professional journal or publication of standards of general circulation, and there is general consensus within the scientific community about the methodology.

11. Required Cleanup to Residential Levels

ISSUE: Currently accepted risk assessment guidance generally requires that reasonably foreseeable uses be considered in setting site-specific risk-based standards. This does not appear to be a requirement when selecting a site-specific remediation level. When future change from non-residential use to residential use is imminent or clearly apparent, the more restrictive residential site-specific remediation level should be applied. Examples of clear and apparent imminent future changes in use might include the filing of a development plan with a local government agency, a rezoning application, an application for building permits, or other publicly available information that suggests a future change in exposure to soils at the site.

In addition, the requirement to remediate to residential site-specific remediation levels on properties where there is currently a residential use is overly stringent where a party conducting the remediation acquires the property (if it does not already own it)

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and transforms it from a residential use to a non-residential use. In such a case, cleanup to non-residential standards should be allowed if the party is willing to record a VEMUR and secure rezoning of the property to non-residential uses. The requirement should be revised to require cleanup to the residential site-specific remediation level on any property where there will be a post-remediation residential use.

Furthermore, the need to honor local zoning decisions should be further specified. Additional flexibility as to the "current residential use" provisions should also be provided. The following language is recommended:

- D. A person conducting a remediation based on concentration levels determined from a site-specific risk assessment shall remediate to the residential site-specific remediation level on any property where there is currently a residential use or on any property zoned for residential use in the current master plan of the local zoning authority. Notwithstanding the provisions of this subsection, a person may remediate to the non-residential site-specific remediation level if the local zoning authority agrees to such alternative remediation level in writing.

ANALYSIS: The purpose of the language in R18-7-205(D) (now R18-7-206(C)) is to ensure that property that meets the definition of residential use is remediated to the residential site-specific remediation level. This is only appropriate for the use of the property after the remediation is completed. A requirement to remediate based on any other date does not allow the owner the choice to remediate to a level appropriate for the intended use. The language in these sections will be revised to reflect the time that the remediation is completed. In doing so, the Department does not believe the term needs to be defined.

Although the Department agrees that property should be remediated to the residential site-specific remediation level if it is likely that the property will be used for residential purposes, the addition of zoning language as recommended is problematic. For example, several zoning classification included mixed uses. This type of zoning allows both residential and light commercial, such as strip malls or gas stations. It is unclear what standard applies in this type of situation. In addition, every city has different types of zoning classifications.

The Department also believes that additional requirements to remediate to the residential site-specific remediation level are not needed. If property is not remediated to the residential site-specific remediation level, a VEMUR must be placed on the property and the owner must restrict the property to non-residential uses. If the use of the property will be changing in the near future to residential, the owner should ensure that the property is remediated to the residential site-specific remediation level. Likewise, if the property is zoned for residential uses only, the owner should remediate to the residential site-specific remediation level. Otherwise, the property can not be used by the owner since the city will not allow it to be used for non-residential purposes. Furthermore, the cities should check the title of the property or the Departmental Repository when issuing building permits and rezoning applications (Please see Issue # 10 in R18-7-208)

RESPONSE: R18-7-206(C) is revised as follows:

- C. A person who conducts a remediation to a site-specific remediation level shall remediate to the residential site-specific remediation level on any property where there is residential use at the time remediation is completed.

12. VEMURs

ISSUE: The provision for VEMUR filing on remediations to non-residential levels should appear in R18-7-206 instead of the sections on standards. This would place the applicability of the VEMUR in subsection (A) of the Section addressing that subject. Also, the content of the sections dealing with remediation standards would not deviate from that subject.

ANALYSIS: The Department agrees that the correct section for VEMUR requirements should be in R18-7-206 (now R18-7-207). R18-7-206(E) will be deleted and R18-7-207 (now R18-7-208) will be revised.

RESPONSE: R18-7-206(E) is deleted. Please see Issue #11 in R18-7-206 for the revision to R18-7-206.

13. Engineering Controls

ISSUE: Several commenters stated that ADEQ has no legal authority, nor is it desirable to limit remediation technologies in advance of the consideration of site-specific factors, cost-effectiveness or remedial effectiveness. Unfortunately, the language in the 2nd sentence implies that institutional and engineering controls can only be used for non-residential remediation. Such an implication is legally incorrect and should be removed from the rule.

The language in the Proposed Rule should be changed to incorporate language in the existing Interim Rules, language which reflects the position of the Task Force and implemented in the Interim Policy (under the Category 2(b) cleanup option) and the Interim Rules. Specifically, the last sentence of this section should be revised to read as follows:

The Department may approve alternative remediation levels greater than the non-residential site-specific remediation levels if it is demonstrated that the site-specific conditions, potential pathways of exposure, and institutional and engineering controls are sufficient to protect human health and the environment.

Others indicated that the requirement for ADEQ to approve the use of institutional and engineering controls should remain in this subsection, however, a revision to reference a risk assessment which develops concentration levels based on these controls should be included. The following language was recommended:

- E. With the approval of the Department, a person may achieve the non-residential site-specific remediation level determined by a risk assessment based on through the use of institutional and engineering controls.

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ANALYSIS: As discussed in Issue # 10 in R18-7-201, levels derived from a site-specific risk assessment must be within a risk range of 1×10^{-6} and 1×10^{-4} . In addition, as discussed in Issue # 14 in R18-7-201, engineering controls can be used to meet the residential site-specific remediation level as long as the remediating party can demonstrate that the controls will be maintained. The purpose of R18-7-205(E) (now R18-7-206(D)) is to explicitly allow the site-specific remediation levels to be attained by evaluating the use of institutional and engineering controls in the risk assessment. This is consistent with the recommendations of the Task Force which agreed that the Soil Remediation Statute intended to limit the risk after remediation to within the risk range. The language will be modified to reflect that institutional and engineering controls can be evaluated in the risk assessment to determine if the appropriate risk level is attained.

RESPONSE: R18-7-206(D) is revised as follows:

- D. With prior approval of the Department, a person may achieve the site-specific remediation levels based on the use of institutional and engineering controls. The approval shall be based, in part, on the demonstration that the institutional and engineering controls will be maintained.

R18-7-206. VOLUNTARY ENVIRONMENTAL MITIGATION USE RESTRICTION (VEMUR)

1. Title of VEMUR

ISSUE: Under R18-7-204, persons who clean up to non-residential levels are required to file the voluntary environmental mitigation use restriction (VEMUR). The term "voluntary" should be deleted from the title as the person who chooses to clean up to non-residential levels is required to file the VEMUR. The use of the term "voluntary" may make this section ambiguous and cause unwanted litigation.

ANALYSIS: The Department agrees that the term "voluntary" may be misleading. However, this is the term used in statute and changing this term raises the issue of statutory consistency. A.R.S. § 49-152 uses the term "voluntary environmental mitigation use restriction" for the vehicle to restrict property to non-residential uses. The statutory intent is to refer to the fact that a remediating party had the choice to remediate to residential or non-residential standards. Hence, they "voluntarily" chose to record the VEMUR.

RESPONSE: No change to the rule.

2. Function of the VEMUR

ISSUE: ADEQ should consider a mechanism to require an automatic check of a site's VEMUR and repository status during the building, excavation, and drilling permit approval process to help prevent future contact with contamination left at depth. For example, the City of Oakland has developed a permit tracking system that is part of the construction building permit database and enables the city to compare proposed construction activity for a given property with the site's remediation status.

ANALYSIS: The Department does not have the authority to require cities to check a property's remediation status. However, ADEQ does agree that cities should check the Repository and/or with the County Recorder to determine any land use limitations. Please see Issue # 21 in R18-7-204 for more discussion on this topic.

RESPONSE: No change to the rule.

3. Property Transfers

ISSUE: Under Arizona law, does the lack of a grantee preclude the VEMUR from running with the land? As currently drafted, what would happen if the current owner were to transfer the property?

ANALYSIS: The statute, not a grantee/grantor transaction imposes the restriction. Until canceled under R18-7-206 (now R18-7-207), the VEMUR will remain a recorded restriction on the property.

RESPONSE: No change to the rule.

4. Approval of VEMURs

ISSUE: This section requires ADEQ to approve whether non-residential levels have been achieved and sign the VEMUR. However, a remediating party who does not seek a Letter of Completion is not required under this rule to provide documents to ADEQ describing the remediation and demonstrating that non-residential SRLs have been attained. In that case, what information would ADEQ use to approve that non-residential levels have been achieved? The rule should include a listing of the criteria ADEQ would apply in evaluating the success of a remediation, the minimum report content and format requirements, and other specifics.

ANALYSIS: A.R.S. § 49-152(B) specifies that the Department shall approve and sign the VEMUR before it is recorded. ADEQ will not sign the VEMUR until it can be demonstrated that the property has been remediated to the non-residential standards. The Department can only make the evaluation by reviewing documents pertinent to the remediation. Therefore, the Department will reference the criteria used in R18-7-208(A)(1) through (4) to determine if non-residential standards have been achieved.

RESPONSE: Please see Issue #11 for the revision to R18-7-207(A).

5. VEMUR Enforcement

ISSUE: It is unclear how ADEQ will enforce the requirement to file a VEMUR. Although the statute requires the owner to file a VEMUR, it would seem to be more administratively efficient for the owner to submit an executed VEMUR to the Department with the other materials necessary for program approval, and have the Department execute and record the VEMUR upon approval. At a minimum, formal Department approval should not be provided until it has received a copy of the recorded VEMUR or the certification required at R18-7-207(C)(4).

ANALYSIS: As stated in the previous issue, ADEQ will not approve and sign the VEMUR until it can be demonstrated that the property has been remediated to the non-residential standards. The Department can only make the evaluation by reviewing documents pertinent to the remediation.

A person choosing to remediate to a non-residential standard should 1st contact the owner of the property, if different from the person remediating, to obtain permission and to notify them of the owner's duties pursuant to R18-7-207. If the owner concurs, he or she must submit the information in R18-7-208(A)(1) through (4) and a signed VEMUR to the Department. One of the Departmental programs listed in either R18-7-202(A) or R18-7-202(B) will review the submitted information to determine whether the non-residential standards have been met. If the non-residential standards have been achieved, the Department signs the VEMUR and sends it to the owner. The owner then submits it, along with the appropriate recording fees, to the appropriate county recorder. After the VEMUR is recorded, the property owner must submit a copy of the recorded VEMUR to the Department. At this point, the Department issues a Letter of Completion, if requested.

If a person who is required to remediate does not record the VEMUR or fails to obtain the owners signature on the VEMUR, the Department will take enforcement action to require the property to be remediated to residential standards. Where remediation is conducted under 1 of the voluntary programs listed in R18-7-202(B) (Please see Issue # 2 in R18-7-202), and the VEMUR is not recorded, a Letter of Completion will not be issued and the matter may be referred to the appropriate regulatory program for enforcement.

RESPONSE: No change to the rule.

6. VEMURs Below Selected Depth Limits

ISSUE: At the April 3, 1997 public hearing in Phoenix, ADEQ officials confirmed that a VEMUR need not be recorded if contaminant concentrations in soil below whatever depth limits are selected in the final rule exceed residential levels. ADEQ should include a sentence in R18-7-206 clarifying that a VEMUR need not be recorded if contaminants in the soil below the depth limits identified in R18-7-204 exceed applicable residential levels.

ANALYSIS: In response to comments received, the Department did not adopt any depth limits (Please see Issue # 15 in R18-7-204). Therefore, no clarification of depth limits is needed.

RESPONSE: No change to the rule.

7. VEMURs Recorded Under the Interim Rule

ISSUE: Sites closed during the duration of the Interim Rule that now have a VEMUR filed with the county recorder may have contamination lower than the proposed residential SRLs. These VEMURs affect property values. Granted, it is not ADEQ's mission to consider property values, but requests will be made to issue a Letter of Completion as defined by the Final Rule in an attempt to remove VEMURs. ADEQ should address this issue as a likely consequence of the proposed Final Rule.

ANALYSIS: Pursuant to R18-7-207(D), an owner can request that the VEMUR be canceled if he or she demonstrates that the property meets the residential standards. Therefore, if the residential SRLs are higher than the concentration of contaminants remaining in the soil and the owner can demonstrate that all conditions of the rule, such as groundwater protection, have been met, the Department will sign a VEMUR Cancellation.

RESPONSE: No change to the rule.

8. VEMURs on Federal Property

ISSUE: Deeds to some federal properties, such as Department of Defense sites, are recorded only at the General Services Administration offices in Washington D.C. For these sites, the County Recorders Office where the property is located may not be the most appropriate location to file a VEMUR.

ANALYSIS: A.R.S. § 49-152 requires the VEMUR to be recorded in the county where the property is located.

RESPONSE: No change to the rule.

9. VEMUR Requirement

ISSUE: The reference to the use of a VEMUR should be placed in this Section as opposed to inserting usage in sections determining standards (R18-7204 and 205). The text could accomplish this by revising R18-7-206(A) as follows:

A. A property owner person choosing to have remediation conducted to a non-residential remediation level who is required to record a VEMUR in accordance with A.R.S. § 49-152(B) shall record, with the County Recorder's...

ANALYSIS: The Department agrees that this section is the correct place for this language.

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RESPONSE: Please see Issue #11 for the revision to R18-7-207(A).

10. VEMUR Recording Deadline

ISSUE: What is the purpose of the 30-day deadline for recording the VEMUR and what is the penalty if the deadline is missed? If the purpose is to insure that the remediating party does indeed record the VEMUR, it should be done in a different manner. The way this is written, the remediating party will be penalized for missing the 30-day deadline rather than for not recording the VEMUR.

In addition, the rule does not clearly state the consequence of failing to record the VEMUR within the time frame. If there is no consequence, then the language should be removed.

If the 30 day period for filing the VEMUR is retained, the date used to determine the start of the period should be the date the letter is received by the property owner instead of the mailing date because mailing time may place some property owners (located far from Phoenix) in an adverse compliance position. The following language should be used:

The VEMUR shall be filed with the County Recorder of jurisdiction after being signed in accordance with subsection (A)(2) of this Section, but in no case more than 30 days after the Letter of Completion is ~~sent to the~~ received by the property owner subject to this article as evidenced by the return receipt.

As a companion piece, a revision to R18-7-207(D) is needed to provide for certified mailing.

ANALYSIS: The 30-day requirement to record a VEMUR was added in order to ensure that notice of property restriction is communicated in a timely manner. As stated in Issue # 5, if the VEMUR is not recorded by the timeframe listed, enforcement action can be taken or participation in the Voluntary Remediation Program can be terminated. Notice which is not timely fails the statutory requirement of communication to affected parties.

The Department agrees that the 30-day clock should begin when the remediating party receives verification from the Department. However, the clock cannot begin when the remediating party receives the Letter of Completion because the Department will not issue a Letter of Completion until a VEMUR is recorded and a copy is submitted to the Department. Therefore, the date the remediating party receives a VEMUR signed by the Department, as evidenced by the return receipt, will be used to begin the 30-day clock for recording a VEMUR.

RESPONSE: Please see Issue #11 for the revision to R18-7-207(A).

11. Confusing Language in VEMUR

ISSUE: The 2nd and 3rd sentences in the subsection (A) may cause some confusion due to inconsistent phrasing and a non-chronological approach. The following revision would provide some additional clarification:

A. The VEMUR shall be:

1. Formatted in accordance with A.R.S. § 11-480 and any other specific requirements of the County Recorder of jurisdiction.
2. Signed by the authorized Departmental representative who signed the letter of completion issued in accordance with R18-7-207.
3. Filed with the County Recorder of jurisdiction after being signed in accordance with subsection (A)(2) of this Section, ~~but in no case more than 30 days after the letter of completion is sent to the property owner subject to this Article.~~

ANALYSIS: The Department agrees that a modification to this subsection would clarify the responsibilities of the remediating party and of the Department. R18-7-206 (now R18-7-207) is revised to state the requirements in a chronological manner.

RESPONSE: R18-7-207 is revised as follows:

- A. A person who remediates to the non-residential SRL, or to the non-residential site-specific remediation level shall submit the information listed in R18-7-208(A)(1) through (4) and a VEMUR signed by the real property owner, as set forth in Appendix B, to the applicable Departmental program listed in R18-7-202(A) or R18-7-202(B). The VEMUR shall be formatted in accordance with A.R.S. § 11-480 and any other specific requirements of the County Recorder of the jurisdiction.
- B. The applicable Departmental program listed in R18-7-202(A) or R18-7-202(B) shall evaluate the complete information described in R18-7-207(A) and verify whether the non-residential SRL or the non-residential site-specific remediation level has been achieved. An authorized Departmental representative shall either sign the VEMUR submitted pursuant to subsection (A) of this Section and return the signed VEMUR by certified mail, or request additional information to make the verification.
- C. A person described in R18-7-207(A) shall record a VEMUR described in R18-7-207(B) with the County Recorder's office where the property is located within 30 calendar days of receipt of the VEMUR signed by the authorized Departmental representative, as evidenced by the return receipt.

12. Approval of VEMUR Cancellations

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ISSUE: In the 2nd sentence, the Department representative should "confirm" or "confirm in writing" that the residential levels have been met; "approve that" sounds a bit awkward.

ANALYSIS: The Department agrees that clarification of the Department's approval of the remediation is needed. ADEQ will not sign the VEMUR Cancellation until it can be demonstrated that the property has been remediated to the residential standards. The only way the Department can make the evaluation is by reviewing documents pertinent to the remediation. Therefore, the Department will reference the criteria used in R18-7-207(C)(1)-(4) (now R18-7-208(A)(1) through (4)) to determine if residential standards have been achieved. In addition, this subsection will be revised to be consistent with subsection (A).

RESPONSE: R18-7-207 is revised as follows:

- D. A real property owner who remediates to the background concentration of a contaminant, to the residential SRL, or to the residential site-specific remediation level and who wishes to cancel a recorded VEMUR shall submit the information required in R18-7-208(A)(1) through (4) and a signed VEMUR Cancellation, as set forth in Appendix C, to the applicable Departmental program listed in R18-7-202(A) or R18-7-202(B). The VEMUR Cancellation shall be formatted in accordance with A.R.S. § 11-480 and any other specific requirements of the County Recorder of the jurisdiction.
- E. The applicable Departmental program listed in R18-7-202(A) or R18-7-202(B) shall evaluate the complete information described in R18-7-207(D) and verify whether the background concentration, the residential SRL, or the residential site-specific remediation level has been achieved. An authorized Departmental representative shall either sign the VEMUR Cancellation submitted pursuant to R18-7-207(D) and return the VEMUR Cancellation certified mail, or request additional information to make the verification.

13. VEMUR Copy Deadline

ISSUE: What is the purpose of the 30-day deadline for providing the document to the Department and what is the penalty if the 30-day deadline is missed.

ANALYSIS: The 30-day requirement to provide a copy of the VEMUR to the Department was added so the Department could issue a Letter of Completion in a timely manner. As stated in Issue #5, if the VEMUR is not provided by the time-frame listed, enforcement action can be taken or participation in the Voluntary Remediation Program can be terminated.

RESPONSE: No change to the rule.

14. Where to Send the VEMUR

ISSUE: Instead of providing a copy of the VEMUR to the "Department", it should be provided to the same person, or at least program, signing off on the document.

ANALYSIS: The Department agrees that it would be helpful to specify where the copy of the VEMUR should be submitted. In addition, this subsection will be revised to be consistent with the rest of the section.

RESPONSE: R18-7-207(F) is revised as follows:

- F. A person who records a document described in R18-7-207 shall provide a copy of the recorded document to the applicable Departmental program described in R18-7-202(A) or R18-7-202(B) within 30 calendar days of the date of recording.

R18-7-207. INITIAL NOTICE AND LETTER OF COMPLETION

1. Redundant Requirement

ISSUE: This subsection is redundant with the provisions of R18-7-202(B) and should be eliminated unless each requirement of the Article is prefaced with the same information.

ANALYSIS: The Department agrees that this subsection is not needed.

RESPONSE: The proposed R18-7-207(A) is deleted.

2. Initial Notice; Applicability

ISSUE: An Initial Notice should not be required for non-voluntary remediations. While such a notice should be required for those parties performing voluntary remediations who wish to obtain a Letter of Completion, imposing this requirement on top of Department program requirements simply will create procedural confusion, especially if remediation activities are undertaken pursuant to an order, a consent order or a consent decree with specific notice requirements.

Moreover, it is unclear why such a notice would be required where a specific program requires more stringent notice procedures (that is, public notice/hearing regarding a proposed RAP). Compliance with program requirements should be sufficient. Each Department can provide information to the registry regarding soil remediations under their oversight.

ANALYSIS: The Task Force discussed this issue at length and decided that the public and the local jurisdictions should be provided notice that remediations will be conducted. The information obtained from the notice will be placed into the Departmental Repository, which is mandated by A.R.S. § 49-152(D). While it is true that Departmental programs will know about any remediations being conducted pursuant to enforcement actions or pursuant to voluntary agreements, other remediations would not be

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known without the submittal of an Initial Notice. In addition, not all programs have public notice requirements regarding remediations conducted under the program.

In order to ensure that all of the necessary information is obtained for the Repository, all remediating parties will be required to submit a notice. It should be noted that remediations conducted during emergency situations will be handled differently (Please see Issue #4). Due to the simple notice required by this rule, the Department does not believe that this will create confusion with notice requirements in specific programs. The Department has also developed a notice form for remediating parties that will make it easy to comply with the notice requirement and will distinguish it from other notice requirements.

RESPONSE: No change to the rule.

3. Initial Notice; Earlier Notice

ISSUE: The term "intent to remediate" is extremely broad and vague. It would appear that, in light of 207(B)(1)(b), the intent to remediate can never occur prior to determining the full lateral and vertical extent of each contaminant to be encountered. The Repository (R18-7-208) would be much more useful if the Initial Notice was provided earlier (that is, the assessment stage) and not pegged to a subjective "intent to remediate." In addition, the "Initial Notice of the Intent to Remediate" should be renamed to "Remediation Intent Notice".

ANALYSIS: Although the Department agrees that notice should be provided as early as possible, requiring notice at the assessment stage may result in parties submitting notice when the property is not contaminated and no remediation will be conducted. The notice should be provided when remediation is imminent or when a Letter of Completion will be requested. As a result, the Department agrees that the title should be renamed to be less ambiguous. The title is now the "Notice of Remediation."

The Department believes that the Notice of Remediation should be submitted when the extent of contamination has been determined because knowing the nature and degree of contamination are key components to selecting remediation activities. For example, the extent of contamination and the concentrations of the contaminants help determine the remediation standard and the remediation technologies. However, the extent of contamination will not be required to be provided in the notice. It is difficult and time consuming to describe the extent of contamination and this type of detailed information can be obtained by reviewing the case file at the Department.

RESPONSE: Please see Issue #6 for the revision to R18-7-209(A).

4. Initial Notice; Emergency Situations

ISSUE: How will the "Initial Notice" provisions apply in emergency situations? The following questions are important for both the potentially responsible parties conducting soil remediation during emergencies as well as for government agencies and their contractors conducting or overseeing emergency soil remediation: 1) Will the initial notice apply during WQARF emergencies (see A.R.S. § 49-282.02)? 2) Does it apply to other emergencies, such as RCRA 40 CFR 265.1(c)(11)? 3) If the initial notice applies during emergencies, when must it be submitted? There may be times during emergency events where it is impractical to submit a notice before taking reasonable emergency action. 4) Can the notice be made verbally to the ADEQ Emergency Phone with a follow up in writing? 5) Will any notice required for emergency actions take into account what may be a general lack of detailed information? Often, emergency decisions must be made to protect public safety without full or complete information about site characteristics and other factors. In emergency situations, the notice may only contain the limited information available at the time. 6) Are government agencies, performing emergency remediation when the agency is not a responsible party, required to submit the notice? Depending on the answers to these questions, it is anticipated that an increase in calls to ADEQ's emergency line and subsequent assessment, documentation and referral activities will occur.

ANALYSIS: The purpose of the Notice of Remediation is to provide information to the public that a remediation will be conducted. This is not possible in emergency situations where remediations must be conducted immediately. In emergency situations, ADEQ's Emergency Response Unit or other emergency response personnel will provide necessary notification to prevent exposures. Remediations conducted pursuant to emergencies are not required to submit a Notice of Remediation. However, any person who continues or initiates soil remediation after the initial emergency response must comply with the notice provisions of this rule.

RESPONSE: Please see Issue #6 for revisions to R18-7-209(A).

5. Initial Notice; Where to Send

ISSUE: Additional clarity may be attained by requiring the notice be sent to the program under whose requirements the remediation is being conducted. This would provide consistency with the stem of subsection (C). An alternative would be to add to the list of required items, the name of the program, but this selection would be inconsistent with the approach used in the next subsection.

ANALYSIS: The Department agrees that this subsection should be consistent with the following subsection. The proposed sections have been renumbered in the adopted rule.

RESPONSE: Please see Issue #6 for the revisions to R18-7-209(A).

6. Initial Notice; Additional Information

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ISSUE: The Initial Notice needs to contain more information to be meaningful. The Initial Notice should include the information needed for the Repository, including the name and address of the owner and of the remediating party; the selected remediation standard; the location and type of contamination; a legal and street address or other applicable site address, etc.

The notice should also include a remediation schedule and, to the extent not covered, an initial evaluation of the 203 factors. The notice should be updated periodically (for example, progress reports, etc.) and all notices should include a standard certification that the information provided is true and accurate.

ANALYSIS: The Department agrees that the name of the remediating party would be helpful in cases where the remediating party is not the same as the owner. However, requiring the location of the contaminants and an evaluation of the factors is very difficult and time consuming and this regulatory burden cannot be justified for the Repository when this information is available from the case file at ADEQ.

RESPONSE: R18-7-209(A) is revised as follows:

A. A person conducting soil remediation shall submit a Notice of Remediation to the applicable Departmental program listed in R18-7-202(A) or R18-7-202(B) prior to beginning remediation. A person conducting a soil remediation during an emergency who has notified the Department in accordance with emergency notification requirements prescribed in A.R.S. § 49-284 is not required to submit a Notice of Remediation. Any person who continues or initiates a soil remediation after the initial emergency response shall submit a Notice of Remediation. A Notice of Remediation shall include all of the following information:

1. The name and address of the real property owner.
2. The name and address of the remediating party.
3. A legal description and street address of the property.
4. A list of each contaminant to be remediated.
5. The background concentration, SRL, or site-specific remediation level selected to meet the remediation standards.
6. A description of the current and post-remediation property use as either residential or non-residential.
7. The rationale for the selection of residential or non-residential remediation.
8. The proposed technologies for remediating the site.

7. Initial Notice; Required Information

ISSUE: It is unclear why both B(1)(c) and B(2) are needed where the remediation level is determined by the use of the property. Is this meant to establish how the cancer risk level within the acceptable 1×10^{-6} to 1×10^{-4} was selected or how the factors in R18-7-203 have been evaluated?

ANALYSIS: The proposed subsection B (now R18-7-209(A)) requires remediating parties to provide information to the public that a remediation will be conducted. The Department believes that the information should include the current property use as well the post-remediation use. In addition, the remediating party should indicate whether they intend to remediate to the residential or the non-residential remediation standard. The selected remediation standard should be consistent with the current use or the post-remediation use of the property. The notice does not require evaluation of the risk range factors.

RESPONSE: No change to the rule.

8. Extent of Contamination

ISSUE: The rule should specify the meaning of "extent", such as to non-detect, to the SRL, or to some fraction of the SRL. Another approach would be to add the following to the end of the sentence after "contaminant(s)":

...at concentrations that exceed an agreed upon site-specific remediation level or, if such level has not been established, a level mutually agreed upon by the person conducting the remediation and the department.

ANALYSIS: This rule sets standards for the remediation of soil. It is not intended to address the extent of contamination. The applicable Departmental program will determine if a site has been adequately characterized. The Notice of Remediation no longer includes the description of the extent of contamination (Please see Issue #6).

RESPONSE: No change to the rule.

9. Pre-Approval of Remediation Levels

ISSUE: The streamlined process for conducting cleanups to background may be eliminated if the proposed rule is adopted. Proposed R18-7-207 can be interpreted as requiring a party seeking to remediate to background levels to obtain ADEQ approval of the proposed cleanup prior to implementing any action. This is contrary to the approach endorsed by the Task Force and agreed to by ADEQ (which included cleanup to background as a Category I(a) cleanup). Cleanups to background should require only: 1) submission of an initial notice letter (as outlined in R18-7-207(B)); and 2) submission of information to ADEQ after completion of the remediation, sufficient to allow ADEQ to certify that cleanup to background has been achieved, if a close-out letter is

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sought. If the Department believes that the text of proposed R18-7-207 already allows this with respect to cleanups to background, language clarifying this point should be included in the Concise Explanatory Statement accompanying the final rule.

ANALYSIS: The Soil Remediation Standards Rule requires a person remediating to background to submit a Notice of Remediation before remediation and to submit information pursuant to R18-7-208(A) after remediation if a Letter of Completion is requested. A person remediating pursuant to a program or an enforcement action may be required to submit more information than that required in this rule and it may be required prior to remediation.

RESPONSE: No change to the rule.

10. Letter of Completion; Groundwater Contamination

ISSUE: A remediating party should be eligible to receive a letter from the Department indicating that soil remediation has been completed, even if groundwater remediation or monitoring continues. However, unless a voluntary component is added to the final rules, the availability of a Letter of Completion is simply confusing, especially since the Department states in the preamble to the Proposed Rule that the Letter of Completion will not be considered a site closeout document under the various Department programs. If the substantive requirements of the program are met, which includes compliance with the soil rules, then the Letter of Completion should constitute a close-out document. The approach taken by the Department with regard to the Letter in the Proposed Rules appears to be a remnant of the voluntary program which serves no purpose without a voluntary component.

ANALYSIS: A Letter of Completion indicates that the Soil Remediation Standards have been achieved. Therefore, a Letter of Completion can be issued even if groundwater contamination remains. In this case, the letter simply states that the soil standards have been achieved, including the groundwater demonstration. It does not state that contamination no longer exists. In regard to the voluntary component, based on comments received, it has been reinserted into the rule (Please see Issue #2 in R18-7-202).

RESPONSE: No change to the rule.

11. Letter of Completion; Evaluating Risk Assessments

ISSUE: How does ADEQ propose to evaluate whether remediation levels selected using site-specific risk assessments are appropriate?

ANALYSIS: Please see Issue #11 in R18-7-201 and Issue #5 in R18-7-205.

RESPONSE: No change to the rule.

12. Letter of Completion; Definition of an Owner

ISSUE: It is unclear whether the term "owner" in R18-7-207(C)(4) refers to the land owner or another owner, such as an owner of an Underground Storage Tank. This term should be defined.

ANALYSIS: The certification is intended to apply to the person conducting the remediation. Therefore, the rule (now R18-7-208(A)(5)) will be modified accordingly.

RESPONSE: R18-7-208(A)(5) is revised as follows:

5. A statement signed by the person conducting the remediation certifying the following:

I certify under penalty of law that this document and all attachments are, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of a fine and imprisonment for knowing violations.

13. Letter of Completion; Required Information

ISSUE: In addition to information about maintenance of engineering controls, ADEQ should require that the person making the request for a Letter of Completion specify any institutional controls and their maintenance. For any type of control, ADEQ should require enough information to understand its purpose and to judge the length of time the control should remain in place to ensure protection of human health and the environment.

ANALYSIS: Proposed R18-7-207(C)(1) (now R18-7-208) requires a description of the activities, techniques, and technologies used to remediate the site including a description of the maintenance of engineering controls. If an engineering or institutional control is used to remediate the site, a description must be provided. This would include the purpose and the length of time the control is needed. However, the Department agrees that institutional controls should be added to the rule language. In addition, the Department is adding language requiring a legal mechanism to ensure that the controls are maintained for the length of time needed to protect human health and the environment.

RESPONSE: R18-7-208(A)(1) is revised as follows:

1. A description of the actual activities, techniques, and technologies used to remediate soil at the site, including the legal mechanism in place to ensure that any institutional and engineering controls are maintained.

14. Close-Out Documents Issued Under the Interim Rule

ISSUE: It is unclear why the new and significantly lower Soil Remediation Levels (SRLs) are not retroactive to sites closed by ADEQ during the effective period of the Interim Rule. The public understands that ADEQ's mission is to protect human health

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and the environment. As such, it is perceived that the proposed SRLs reflect today's good science definitions of chemical concentrations protective of human health. The public now questions if former Health Based Guidance Levels (HBGLs) can be considered protective of human health based on today's good science. For example, the residential HBGL for benzene is 47 mg/kg. The proposed SRL is 0.62 mg/kg. If evidence supports that the Interim Rule resulted in the closure of sites that still present a risk to the public and environment, then the Final Soil Remediation Standards Rule needs to address the appropriate corrective actions necessary.

Another concern is that lending facilities and potential buyers may argue that a site closed under the Interim Rule was not cleaned up to standards that are protective of human health and the environment since the HBGLs did not include the inhalation and dermal pathways. There should be some mechanism in the Final Soil Remediation Standards Rule which would enable those people who close under the interim levels to be able to feel safe and secure that their property is marketable and that the closure under the Interim Rule would not jeopardize the future marketability of their property. ADEQ could issue a Letter of Completion for sites closed during the effective period of the Interim Rule stating that chemicals, such as benzene which has HBGLs 75 times higher than the proposed SRLs, are protective of human health and the environment and will not require further corrective action by ADEQ.

In addition, during informal questions at the April 2, 1997 public hearing, ADEQ offered that both the HBGLs and SRLs are very conservative and both are protective of human health. This comment suggests that there is no need for the SRLs and that they are overly conservative regulations likely to frustrate industry and could be legally challenged. It was also stated by ADEQ that close-out letters did not state that the site was protective of human health and the environment, rather, it stated the site met the remediation standards. ADEQ should be aware that public support of this agency comes from the trust that the regulations it promulgates are necessary and protective of human health and the environment. Debating the technical wording of the close-out letter is not going to solve the problem.

ANALYSIS: The Department cannot require sites closed according to the Interim Soil Remediation Standards to remediate to the Final Soil Remediation Standards. A.R.S. § 49-152 mandated the Department to adopt the HBGLs developed by ADHS as emergency rules until final standards could be developed. The HBGLs were based on soil ingestion and did not address the health risks from inhalation and dermal exposure. However, it should be noted that chemical concentrations in soils that exceed the HBGLs may not represent a health risk. Rather, the HBGLs are concentrations of contaminants that do not represent a health risk based on the exposure assumptions used in the calculations. Close-Out Documents, issued under the Interim Soil Remediation Standards Rule, only state that a site is remediated to the remediation standards. The same is true of a Letter of Completion issued under the Final Soil Remediation Standards Rule.

The Task Force has consistently recommended that the Soil Remediation Standards should include multiple exposure routes. In addition, the Task Force worked hard to provide an enabling statute for the risk-based soil remediation standards. However, it was not anticipated that there would be an Interim Rule and that the Department would be mandated to adopt the HBGLs as pre-determined standards.

Requiring remediation to meet standards which change over time subjects remediating parties to endless remediation efforts. Therefore, the Department believes that remediation standards should not be retroactive. However, if any situation exists where there is an imminent and substantial endangerment to public health and the environment from a remediation completed during the Interim Soil Remediation Standards Rule, the Department can take action to mitigate the problem.

RESPONSE: No change to the rule.

15. Certified Mailing

ISSUE: If the 30-day window for filing a VEMUR is retained in R18-7-206, subsection R18-7207(D) should be revised as follows:

- D. The applicable Departmental program...shall issue a Letter of Completion by certified mail with return receipt requested or request additional information.

ANALYSIS: The Department did retain the 30-day requirement for recording a VEMUR. However, the Letter of Completion was not used to begin the 30-day clock for recording a VEMUR (Please see Issue #10 in R18-7-206).

RESPONSE: No change to the rule.

16. rescinding Letter of Completion

ISSUE: The Department should not be able to revoke or amend a Letter of Completion if it determines that the information submitted on the remediation was "incomplete." That determination should be made by the Department prior to issuing the letter.

ANALYSIS: The Department agrees that it should not revoke a Letter of Completion if information submitted on the remediation was incomplete. The rule will be revised accordingly.

RESPONSE: R18-7-208(C) is revised as follows:

- C. The applicable Departmental program listed in R18-7-202(A) or R18-7-202(B) may revoke or amend any Letter of Completion if any of the information submitted pursuant to R18-7-208(A) and R18-7-207(F) is inaccurate or if any condition was unknown to the Department when the Department issued the Letter of Completion.

17. Time-frames for ADEQ

ISSUE: The 60-day deadline for ADEQ to respond to a final report or closure request should be added back into the final rule. The rule removes the timeline which required ADEQ to provide a close-out document, deny, or request additional information necessary to issue a Close-Out Document within 60 days after receiving a final report. (See the Interim Rule R18-7-207, Section G). This deadline is necessary to give property owners a level of certainty in property transactions.

ANALYSIS: This rule sets forth cleanup standards for soil remediations. It does not take the place of any requirements of the Departmental programs which regulate soil remediations. The deadline was removed from the rule because the individual programs may have requirements in addition to the ones listed.

RESPONSE: No change to the rule.

18. Zoning Requirements

ISSUE: This section does not include the requirement from the Interim Rule, R18-7-208(E)(4), which required a proof of zoning from the appropriate zoning authority. The Cleanup Standards/Policy Task Force adopted a mechanism where a city would receive notice if there was a proposal to clean up a residentially zoned property that is currently being used for residential purposes to a non-residential level. In the alternative, the Task Force endorsed a mechanism where the remediating party would go to the city and receive proof of zoning to bring back to the program. The Department should adopt 1 or the other of those mechanisms.

For example, a party conducting a cleanup might choose to purchase a residential property where there is currently a homeowner on the property, relocate that home owner, go through the city zoning process, rezone that property to a non-residential zoning category, and cleanup to a non-residential cleanup level. That in fact is the process that the Task Force contemplated would take place. The Task Force did not contemplate that there would be residential properties cleaned up to non-residential levels without the city zoning processes being honored.

ANALYSIS: All persons remediating soil must submit a Notice of Remediation to the Department indicating that they will be remediating the property (Please see Issue #2). The notice includes property use information and the selected remediation level. These notices will be entered into a Repository of sites which will be available to local jurisdictions (Please see Issue #9 in R18-7-208). The cities can review the Repository and take whatever action is appropriate.

RESPONSE: No change to the rule.

R18-7-208. PUBLIC ACCESS TO INFORMATION

1. Source of Information

ISSUE: All information to be entered in the Repository should be provided by the property owner in a separate document or form prior to receiving the Letter of Completion. Providing the requested information in a standard format would reduce the amount of resources used to search for this information in the case file or in a remediation report.

ANALYSIS: Remediating parties must submit a Notice of Remediation for sites proposed to be remediated pursuant to R18-7-207(A) (now R18-7-209(A)) (Please see Issue # 3 in R18-7-207). A standard format has been developed by the Department for this notice. Information regarding sites which have been remediated is available from the Letter of Completion. Although a form has not been developed for the Letter of Completion, a format to enter sites into the Repository is available.

RESPONSE: No change to the rule.

2. Sites Listed

ISSUE: Sites where ADEQ has knowledge that remediation is proposed, ongoing, or completed should be listed in the Repository. In addition, the sites included in the repository should be as inclusive as possible and should include, at a minimum, those sites that have been assessed by the Department or for which the Department has received the results of an assessment.

ANALYSIS: The Department agrees that proposed, ongoing, and completed sites should be listed in the Repository. However, the Department does not believe that every site assessed should be listed in the Repository. Some people may conduct sampling which indicates no presence of contaminants. Therefore, all sites which have had a Notice of Remediation filed, as well as any site which has a Letter of Completion issued, will be listed.

RESPONSE: No change to the rule.

3. Reorganization

ISSUE: This section should be reorganized and rewritten to state, in the following order, that ADEQ will create a Repository; that the Repository shall contain a listing of sites proposed for remediation, undergoing remediation, or at which remediation has been completed; and specify the minimum information that the Repository shall contain about the sites.

ANALYSIS: The Department agrees that reorganization would be helpful.

RESPONSE: Please see Issue # 7 for the revision to R18-7-209.

4. Additional Information

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ISSUE: Several comments indicated that additional information should be listed in the Repository. Some stated that the name and address of the remediating party, such as a tenant, should be listed if different from the owner, since the owner may not always be able to respond to inquiries about the remediation project.

Other commenters indicated that the information for completed projects should be somewhat more detailed than for other Repository listings because this information may be the only readily accessible information. For completed projects, a brief description of the location and the lateral and vertical extent of remaining contamination, including the minimum depth to contamination should be included in the Repository. This is critical to provide notice that contaminants have been left at depth, if in fact that proposal is approved. Someone accessing the repository should be able to determine the contaminant of interest as well as the relative variations in concentration throughout the contaminated volume of soil. A description of the nature, purpose, intended life, and maintenance of any institutional or engineering controls which are part of the soil cleanup objectives should also be listed.

In contrast, others felt that information regarding location and depth should remain a matter of case file review. Individuals with an interest in the properties can use their own resources to conduct research for any detailed information. Including all the above listed information in the database will condemn a large portion of ADEQ's limited resources to database maintenance and management. Additionally, quality assurance/quality control standards for some of this information will need to be rigorous, and therefore costly. Finally, given that several thousand cases have been closed without placing contaminant information into the existing databases, it is recommended that the requirement for contaminant information not be retroactive.

ANALYSIS: The Department agrees that additional information should be listed in order to provide sufficient notice to the public. This includes: the name of the remediating party; the contaminants remediated; and a description of the institutional and engineering controls. However, the Department agrees that listing too much information will be resource intensive. Therefore, information regarding the location and extent of contamination will be deleted. This information is readily available elsewhere. In regard to the effective date of this requirement, the rule would not apply to cases closed before the effective date of the Final Soil Remediation Standards Rule (Please see Issue # 11 in R18-7-202).

RESPONSE: Please see Issue #7 for revisions to R18-7-209.

5. Property Transfers

ISSUE: Will the property owner listed in the repository remain the owner at the time remediation is completed or will the listed property owner be updated as ownership changes?

ANALYSIS: A.R.S. § 49-152 only refers to owners of property submitting the listed information. Therefore, the Repository will only list the owner at the time the remediation was completed.

RESPONSE: No change to the rule.

6. Date of Completion

ISSUE: The Underground Storage Tank program (UST) tracks the date that a close-out document was sent, not the date remediation was completed. This is partly due to the fact that such a date is difficult to define. For example, the date could be: when the remedial technology was turned off; the samples taken; the sample analyses were completed; the report was submitted; or the report was approved. Tracking the date that the Letter of Completion was sent would be simpler and easier than the date that remediation was completed.

ANALYSIS: The Department agrees that the issue date of the Letter of Completion is most appropriate. The rule will be changed accordingly.

RESPONSE: Please see Issue #7 for revisions to R18-7-209.

7. Remediation Standard Achieved

ISSUE: It is unclear what is meant by "remediation standard achieved." It is assumed that this means whether or not a VEMUR was completed for the property.

ANALYSIS: The remediation standard achieved indicates whether the site was remediated to the SRLs, a site-specific remediation level, or a background level. This will be clarified in the rule. The rule will also add a provision to indicate whether residential or non-residential standards were achieved.

RESPONSE: R18-7-209(B) is revised as follows:

B. The Department shall establish and maintain a repository for information regarding sites where soil is remediated. The Repository shall include a listing of sites for which a Notice of Remediation has been submitted or a Letter of Completion has been issued.

1. For sites where a Notice of Remediation has been filed, the Repository shall contain the date the notice was filed and the information submitted as described in R18-7-209(A).
2. For sites where a Letter of Completion has been issued, the Repository shall contain the following:
 - a. The name and address of the real property owner.

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- b. The name and address of the remediating party.
- c. A legal description and street address of the property.
- d. A listing of each contaminant that was remediated.
- e. The background concentration, SRL, or site-specific remediation level selected to meet the remediation standard.
- f. A description whether the residential or non-residential standard was achieved.
- g. A description of any engineering or institutional control used to remediate the site.
- h. The date when the Letter of Completion was issued.

8. Characterization

ISSUE: The proposed rule is unclear concerning what is required to characterize "the lateral and vertical extent of contamination." There have been instances in the past which ADEQ has cited similar language as justification for requiring characterization of contaminants to non-detect or to background levels. Since the site-specific remediation levels for most contaminants will be hundreds and thousands of times greater concentrations than non-detect or background, characterization of soil contamination to these levels is neither sensible nor technically justifiable. For example, the SRLs for naturally occurring inorganics are frequently much higher than naturally occurring concentrations. The proposed residential SRLs for copper and zinc are 2,800 mg/kg and 23,000 mg/kg, respectively. Both these SRLs are much higher than naturally occurring levels. Therefore, characterizing the lateral and vertical extent of copper and zinc in soil incurs unnecessary cost with no added benefit to human health. The following proposed additional language makes it clear that determination of the level of contamination for which characterization is required must be done on a case-by-case basis and must bear some reasonable relationship to likely remediation levels:

Each contaminant that has been remediated, the location of the contaminants remediated, and the extent of contamination at concentrations that exceed an agreed upon site-specific remediation level or, if such level has not been established, a level mutually agreed upon by the person conducting the remediation and the department.

ANALYSIS: This rule sets standards for the remediation of soil. It is not intended to address the extent of contamination. The programs listed in R18-7-202(A) and R18-7-202(B) will determine if a site has been adequately characterized. However, the Repository no longer includes a description of the extent of contamination (Please see Issue # 7).

RESPONSE: No change to the rule.

9. Availability

ISSUE: Several commenters indicated that the Department should maintain a complete Repository at the Phoenix location and the appropriate portions of the Repository at the various regional offices of ADEQ. The listing should be available in electronic format upon request. In the future, ADEQ should pursue the means to provide this information via the Internet to enhance public access. This would also help address public concerns that the information is only available from ADEQ during normal business hours, significantly limiting access by the working public.

Other commenters stated that timely notice to local jurisdictions is extremely important when a basic criteria in setting a remediation level is the use of the property to be remediated. The provisions to only "periodically provide a list of sites" is not very definitive and does not ensure timely notice to local jurisdictions. Similar issues have been generally raised by local governments in the past with respect to the Department's efforts to comply with A.R.S. § 49-111. It is detrimental to everyone involved if remediation is pursued on a mistaken assumption on zoning for a particular site. It would be far better to provide the local jurisdiction with a copy of the notice at the time that it is submitted to ADEQ, or at least to set definitive time lines for providing a list of sites (such as monthly).

In contrast, 1 commenter indicated that additional resources will be required for the Department to notify the cities and counties of sites being remediated in their jurisdiction. The cities and counties should be able to use the repository to obtain any necessary information using their own resources. As it is unlikely that money will be provided to maintain the database and provide these reports, it is recommended that the self-imposed periodic reporting to local jurisdictions be removed.

ANALYSIS: The Department agrees that the Repository should be maintained at the Phoenix location as well as the regional offices. The Department also agrees that timely notice to local jurisdictions is important. As a result, the Department intends to make the Repository available on the Internet. This will allow continuous access of all Notice of Remediations filed as well as Letter of Completions issued by the Department. When available, interested parties can access the Repository at www.adeq.state.az.us/. In the meantime, the Repository is available at the Phoenix office in Customer Service.

RESPONSE: R18-7-209(B)(3) is revised as follows:

- 3. The Repository will be available for public review during the Department's normal business hours. A person who wishes to obtain copies of the Repository shall pay a copying fee established by the Department.

10. VEMUR Review Requirement

ISSUE: ADEQ should consider adding another section to require an automatic check of a site's VEMUR and repository status prior to the issuance of any State or local government permits for excavation, drilling, building etc. to prevent future contact

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with any contamination left at depth. The purpose of such a mechanism would go beyond simply making the data available to the public and actually require that the information be examined prior to permit approval.

The same type of mechanism could alert ADEQ to upcoming property transfers. An automatic check of the site's VEMUR and repository status would determine whether institutional or engineering controls should be maintained by the new property owner in order to protect human health and the environment.

ANALYSIS: The Department has no authority to require cities to check a property's remediation status. However, ADEQ does agree that cities should check the Repository and/or with the County Recorder to determine any land use limitations. Please see Issue #21 in R18-7-204 for more discussion on this topic.

RESPONSE: No change to the rule.

APPENDIX A. SOIL REMEDIATION LEVELS (SRLS)

1. List of Chemicals

ISSUE: Although the number of compounds listed in Appendix A has expanded overall since the Interim Rule, some compounds appear to have been removed, for example acenaphthylene and other PAHs. Were these omissions intentional or an oversight?

ANALYSIS: Appendix A of the Interim Rule (the HBGLs) listed 503 chemicals (including a few synonyms). A number of new chemicals appear on the SRL list because toxicity values became available since the HBGL list was last updated. Approximately 30 chemicals with HBGLs were removed from the SRL list. In most cases, chemicals were removed because toxicity values used for the HBGL list could not be verified or were not referenced in EPA toxicology databases (this includes acenaphthylene). Some chemicals were removed since they are present in a gaseous state at standard temperatures and pressures and it was not logical to include them in a list of soil cleanup levels. Uranium was eliminated from the list since its toxicity depends upon the isotopic makeup of the sample and setting a single cleanup level would be inappropriate. White phosphorus (CAS # 7723-14-0) was unintentionally removed from the list.

RESPONSE: SRLs for white phosphorus have been added to Appendix A.

2. Analytical Methods

ISSUE: Appendix A should reference the required EPA analytical method to determine the concentration of chemicals in the soil. Currently, a representative from 1 ADEQ program may require a particular method at 1 site and another ADEQ program may require a different method or suggest a different EPA method at another site. These ambiguities could lead to different soil remediation levels. There needs to be a mechanism in the rules which assures that all soil samples are analyzed using the same methodology.

ANALYSIS: The Department cannot reference the required analytical method in Appendix A because EPA revises methods as new information becomes available. For example, EPA Test Methods 8010 and 8020 for volatile organic analytes, have recently been replaced with Method 8021. If the methods were referenced in this rule, the new methods could not be used, even if they were the only ones available. Remediating parties should consult with the applicable Departmental program to ensure that the correct analytical method is being used.

RESPONSE: No change to the rule.

3. Method Detection Limits

ISSUE: ADEQ and ADHS should implement a notification procedure to inform all state-certified laboratories on how the Final Soil Remediation Standards Rule will affect their reporting requirements. This includes: 1) Detection limits and method reporting limits must be as low as the SRLs; and 2) Laboratory methods which report hydrocarbons would have to be specific to hydrocarbon chains with 9 or greater hydrocarbons (C9+) to allow for comparison with the hydrocarbon SRLs.

ANALYSIS: There is not a standard detection limit for any method. Different programs may have different regulatory limits that use the same analytical method. Therefore, the laboratories can select the detection limit for each method. ADHS certifies that laboratories can achieve the detection limits that the laboratory has selected for the methods in which they are requesting certification.

As a result, the methods may not always reflect a detection limit lower than the SRL. In addition, even though a laboratory is able to achieve a specified detection limit for a particular method does not necessarily mean that a sample will be analyzed to that method detection limit. For example, a laboratory may indicate that the detection limit for a contaminant using a particular method is 1 mg/kg but may not analyze to that level unless specifically requested to do so. On the other hand, if the SRL for the same contaminant is much greater than 1 mg/kg, the remediating party may not want to analyze all of the samples down to the detection limit. In short, it is the responsibility of the remediating party to ensure the laboratory can achieve the detection limit needed to satisfy the regulatory limit.

RESPONSE: No change to the rule.

4. Groundwater Protection

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ISSUE: The Groundwater Protection Levels (GPLs) calculated for risk via migration to groundwater should be included in Appendix A.

ANALYSIS: The GPLs were published as part of the guidance on leachability entitled "A Screening Method to Determine Soil Concentrations Protective of Groundwater Quality." The rule does not require the use of the GPLs or the guidance. Alternative approaches to evaluate protection of groundwater may be used. Therefore, the GPLs are not referenced in the rule.

RESPONSE: No change to the rule.

5. Brand Names

ISSUE: At least 232 of the 556 substances listed in Appendix A are pesticides either currently or historically used. These appear as a mix of either common chemical names or specific brand names. An individual seeking to use this appendix as proposed would need to look for both the common chemical name and the brand name to determine the appropriate SRL. It would be more convenient to use the common chemical name rather than the brand name, as there are often multiple brands of the same chemical. For example, entry # 67 lists biphenthrin with Talstar in parentheses. The common name for this chemical is bifenthrin. In addition, Talstar is a brand containing this active ingredient, but the major agricultural brand is Capture.

ANALYSIS: The Department agrees that the chemicals should be listed by the common chemical name for the active ingredient. Unfortunately, there are often several chemical names for the same active ingredient. In order to facilitate the use of Appendix A, the Department will develop a list a synonyms for different chemical names and brands, but the list will not be included in the rule.

RESPONSE: No change to the rule.

APPENDIX B. NOTICE OF VOLUNTARY ENVIRONMENTAL MITIGATION USE RESTRICTION

1. Content of VEMUR

ISSUE: ADEQ should consider including a requirement to incorporate as part of the VEMUR a description of the lateral and vertical extent of contamination remaining at the site above SRLs. The proposed rule already requires the person conducting remediation to submit information on the lateral and vertical extent of contamination prior to remediation and to submit confirmation (in the form of soil sampling data) of the remaining extent of contamination as part of the request to ADEQ for a Letter of Completion. Including this information in the VEMUR would not pose any additional reporting burden.

ADEQ should also require as part of the VEMUR a description of the nature, purpose, and intended life of any institutional or engineering controls which are part of the soil cleanup objectives. In addition, information regarding necessary maintenance of engineering controls, which is already required of persons conducting remediation to specify in the request to ADEQ for a Letter of Completion, should be included in the VEMUR.

The additional VEMUR information suggested above would provide meaningful information to persons purchasing property. Future property owners would know whether any engineering or institutional controls are necessary to protect human health and the environment. Most importantly, the owner would know how to properly maintain any controls and the length of time to continue such maintenance. Information on any remaining soil contamination above SRLs would guide decisions about future excavation, drilling, building, or other construction-related activities in a property improvement project.

ANALYSIS: A remediating party is no longer required to submit a description of the extent of contamination for the Notice of Remediation (Please see Issue #3 in R18-7-207). Although analytical data are required in order for the Department to issue a Letter of Completion, this information is very detailed and difficult to summarize. The same is true for information on engineering controls. It is most appropriate for the property owner to identify that the property has been restricted and obtain the complete case file on the property from the Department.

The Department believes that the VEMUR is not the appropriate mechanism to ensure maintenance of engineering controls. The limited information provided on the VEMUR form would not be sufficient to apprise future owners of requirements to maintain any controls. In fact, the party conducting the remediation must guarantee the controls stay in effect. Therefore, some other legal mechanism to assure maintenance is warranted if engineering controls are part of the soil remediation. Please see Issue #13 in R18-7-207.

RESPONSE: No change to the rule.

The following list of acronyms and references are used throughout the CES.

LIST OF ACRONYMS

1×10^{-4}	1 in 10,000
1×10^{-5}	1 in 100,000
1×10^{-6}	1 in 1,000,000
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
APP	Aquifer Protection Permit
ARARs	Applicable or relevant and appropriate state requirements

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ASTM	American Society for Testing and Materials
AWQS	Aquifer Water Quality Standards
BTEX	Benzene, Toluene, Ethelbenzene, and Xylene
(C _{sat})	Soil saturation concentration
EPA	United States Environmental Protection Agency
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CES	Concise Explanatory Statement
CFR	Code of Federal Regulations
EIS	Economic Impact Statement
ELCR	Excess Lifetime Cancer Risk
GPLs	Groundwater Protection Levels
HBGLs	Health-Based Guidance Levels
HI	Hazard Index
HQ	Hazard Quotient
HWM	Hazardous Waste Management
LC ₅₀	Lethal Concentration 50
LD ₅₀	Lethal Dose 50
LOAELs	Lowest observed adverse effect levels
MCLs	Maximum contaminant levels
mg/kg	Milligrams per kilogram (see PPM)
µg/dl	Micrograms per deciliter
NOAELs	No observed adverse effect levels
PAHs	Polynuclear aromatic hydrocarbons (a.k.a. Polycyclic aromatic hydrocarbons)
PCBs	Polychlorinated biphenyls
PPM	Parts per million
PRG	EPA Preliminary Remediation Goal
RBCA	Risk-based corrective action
RCRA	Resource Conservation and Recovery Act
RfDs	Reference dose
RME	Reasonable Maximum Exposure
SAF	State Assurance Fund
SRLs	Soil Remediation Levels
SSCLs	Suggested Soil Cleanup Levels
SSLs	Soil Screening Levels
SWSWM	Solid Waste and Special Waste Management
TPH	Total Petroleum Hydrocarbons
TSCA	Toxic Substances Control Act
USGS	United States Geological Society
UST	Underground Storage Tank Program
VRP	Voluntary Remediation Program
WQARF	Water Quality Assurance Revolving Fund
WQS	Water Quality Standards
VEMUR	Voluntary Environmental Mitigation Use Restriction

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11. Any other matters prescribed by statute that are applicable to the specific agency or to any specific rule or class of rules:
None

12. Incorporation by reference and their location in the rules:
None

13. Was this rule previously adopted as an emergency rule?
If yes, please indicate the Register citation: 2 A.A.R. 1484, April 19, 1996

14. The full text of the rules follows:

TITLE 18. ENVIRONMENTAL QUALITY

**CHAPTER 7. DEPARTMENT OF ENVIRONMENTAL QUALITY
REMEDIAL ACTION**

**ARTICLE 1. WATER QUALITY ASSURANCE
REVOLVING FUND**

Section
R18-7-109. Remedial Action Requirements; Level and Extent of Clean Up

**ARTICLE 2. INTERIM SOIL REMEDIATION-
STANDARDS SOIL REMEDIATION STANDARDS**

Section
R18-7-201. Definitions
R18-7-201. Definitions
R18-7-202. Applicability
R18-7-202. Applicability
R18-7-203. Remediation Standards
R18-7-203. Remediation Standards
R18-7-204. Background Concentration Levels
R18-7-204. Background Remediation Standards
R18-7-205. Health-Based Guidance Levels (HBGLs)
R18-7-205. Pre-Determined Remediation Standards
R18-7-206. Site-Specific Remediation Levels
R18-7-206. Site-Specific Remediation Standards
R18-7-207. Voluntary Environmental Mitigation Use Restriction (VEMUR)
R18-7-207. Voluntary Environmental Mitigation Use Restriction (VEMUR)

tion (VEMUR)

R18-7-208. Initial Notice; Final Report; and Close-Out Document
R18-7-208. Letter of Completion
R18-7-209. Public Access to Information
R18-7-209. Notice of Remediation and Repository
Appendix A. Human Health-Based Guidance Levels (HBGLs) For Ingestion of Contaminants In Soil
Appendix A. Soil Remediation Levels (SRLs)
Appendix B. Notice of Voluntary Environmental Mitigation Use Restriction
Appendix B. Notice of Voluntary Environmental Mitigation Use Restriction
Appendix C. Cancellation of Voluntary Environmental Mitigation Use Restriction by Owner
Appendix C. Cancellation of Voluntary Environmental Mitigation Use Restriction Cancellation
Appendix D. Sample Seller's Disclosure Language

**ARTICLE 1. WATER QUALITY ASSURANCE
REVOLVING FUND**

R18-7-109. Remedial action requirements; level and extent of clean up
A. All remedial actions shall meet the following requirements:

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1. Remedial actions shall be reasonable and necessary to prevent, minimize or mitigate danger to public health or welfare or to the environment from the release or threatened release of a hazardous substance.
 2. Remedial actions shall provide for the control, management or cleanup of a release or threatened release of a hazardous substance so as to allow the maximum beneficial use of the waters of the state. For remedial actions that may affect surface water, the evaluation of beneficial use must include the protection of surface water as required pursuant to R18-11-201 through R18-11-214 and R18-11-303. For remedial actions that may affect aquifers, the evaluation of beneficial use must include protection of drinking water pursuant to A.R.S. § 49-223, unless the aquifer or that part of the aquifer affected by the remedial action has been reclassified by the Director for a non-drinking water protected use pursuant to A.R.S. § 49-224(C).
 3. Remedial actions shall be cost-effective over the period of actual or projected exposure to health or welfare or the environment from a release or threatened release of a hazardous substance. In evaluating cost-effectiveness, the Director shall take into account the total short-and long-term costs of the remedial action, including the costs of operation and maintenance.
 4. Remedial actions shall be consistent with A.R.S. §§ 45-401 through 45-655, which includes all applicable and adopted Active Management Area Plans, Irrigation Non-expansion Area Plans, and all other applicable water management requirements, plans or permits.
 5. Remedial actions shall be consistent with A.A.C. R18-7-201 through R18-7-209.
- B. Subject to meeting remedial action requirements, and except for health risk assessments and health effects studies, the Director shall favor the selection of remedial actions that permanently and significantly reduce the volume, toxicity or mobility of a hazardous substance when it is practicable, cost-effective and necessary to protect public health or welfare or the environment.
- C. The Director shall require an expedited interim or permanent remedial action for cleanup when any of the following applies:
1. There is an actual or potential direct contact with a hazardous substance by a human or animal population.
 2. There are drums, barrels, tanks or other bulk storage containers that pose a danger or threat of a danger to public health or welfare or the environment.
 3. There are contaminated soils that pose a danger or threat of danger to public health or welfare or the environment.
 4. There is a danger or threat of danger from fire or explosion.
 5. There are weather conditions that cause the migration of the hazardous substance to accelerate and cause a threat to public health or welfare or the environment.
- D. Subject to meeting remedial action requirements and considering remedial action criteria in establishing the level and extent of cleanup, the Director shall:
1. Require that remedial actions are appropriate under the circumstances presented by the release or threatened release of the hazardous substance. In determining what is appropriate, the Director shall consider the circumstances of the release or threatened release, the population at risk, the beneficial uses of waters of the state, the environmental media affected, and the most current scientific, medical and engineering information available.
 2. Require that the remedial actions conform to the following statutes and rules, and any amendments thereto, when applicable:
 - a. Surface Water Quality Standards adopted by the Department as R18-11-204 and R18-11-205.
 - b. Groundwater Quality Standards adopted by the Department as R9-21-403 and drinking water aquifer water quality standards adopted by A.R.S. § 49-223(A).
 - c. Hazardous waste corrective action rules adopted by the Department as R18-8-264(A) for those facilities required to obtain a hazardous waste permit pursuant to R18-8-270.
 - d. Corrective action requirements authorized under A.R.S. § 49-1005 pertaining to releases from underground tanks that contain regulated substances as defined by A.R.S. § 49-1001(8).
 3. Require cleanup to a level sufficient to prevent or abate an imminent and substantial danger to public health or welfare or the environment where there are no standards established in law for a particular hazardous substance.

ARTICLE 2. INTERIM SOIL REMEDIATION STANDARDS

R18-7-201. Definitions

In addition to the definitions provided in A.R.S. §§ 49-151 and 49-152, the following definitions apply in this Article:

1. ~~"Aquifer Protection Program" means the program described in Title 49, Chapter 2, Article 3 and A.A.C. Title 18, Chapter 9, Article 1.~~
2. ~~"Background" means the concentration of a naturally-occurring contaminant in like lithology and soils within close proximity to, but not affected by, a release.~~
3. ~~"Carcinogen" or "carcinogenic" means a substance which has a cancer group designation of Class A, B1 or B2, but does not include a substance having cancer group designations C, D, E, or D. The cancer group designation is found in Appendix A to the rule.~~
4. ~~"Close-out Document" means a Departmental statement which indicates whether the property in question has met the standards set forth in this Article.~~
5. ~~"Closing" means the point in a real property transaction when all contingencies are removed and the sale becomes final.~~
6. ~~"Contaminant" means a substance which is known or suspected to have an adverse impact on human health or the environment when released, emitted, discharged or spilled into the environment.~~
7. ~~"Department" means the Arizona Department of Environmental Quality.~~
8. ~~"Deterministic risk assessment methodology" means a point-specific risk assessment. In the equation used to calculate risk, each parameter of exposure and toxicity is a single point estimate for each receptor evaluated (that is lifetime resident, adult resident, adult resident or young child resident). Upper bound values are generally used in the risk calculation and the resulting risk estimate is likely to overstate the actual risk to any one individual.~~
9. ~~"Groundwater" means the water in an aquifer as found in A.R.S. § 49-201(2).~~
10. ~~"Hazardous Waste Disposal Program" means the program described in Title 49, Chapter 5, Article 2 and A.A.C. Title 18, Chapter 8, Article 2.~~

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11. "Health-Based Guidance Levels" or "HBGLs" means the pre-determined risk-based standards developed by the Arizona Department of Health Services pursuant to A.R.S. § 49-152(A)(1)(a) as found in Appendix A of the rule.
12. "Leachability" means the ability of a contaminant to move in the subsurface in such a manner that there is a reasonable probability that the contaminant will impact groundwater quality.
13. "Migrate" or "migration" means the movement of contaminants from the point of release, emission, discharge or spillage through the soil profile.
14. "Non-residential Exposure Assumption" means an average ingestion rate of 50 milligrams per day of soil, an exposure frequency of 250 days per year, and an exposure duration of 25 years.
15. "Nuisance" has the meaning found in A.R.S. § 49-141.
16. "Person" means one who is subject to the provisions of R18-7-202(A).
17. "Probabilistic risk assessment methodology" means substituting probability distributions for the point estimate input variable in the equations used to calculate exposure dose and risk. The resulting distribution provides a full characterization of risk and corresponding risk percentiles for all exposure levels.
18. "Registry" means the Departmental database of information from which the public may view voluntarily submitted notices, reports, applications, remedial reports pursuant to a Departmental enforcement action, and other public information related to proposed, pending or completed remediation projects.
19. "Residential Exposure Assumption" means an average ingestion rate of 120 milligrams per day of soil, an exposure frequency of 365 days per year, and an exposure duration of 30 years.
20. "Residential Protection" means an excess lifetime cancer risk level of 1×10^{-6} and a Hazard Index of no greater than one based on a standard residential exposure assumption without the use of institutional or engineering controls.
21. "Residential Use" has the meaning found in A.R.S. § 49-151(3).
22. "Remediate" or "remediation" has the meaning found in A.R.S. § 49-151(2).
23. "Risk assessment" is a scientific evaluation of the risk to human health from the exposure to a specific type and concentration of contaminant. A risk assessment contains four components: identification of potential chemicals of concern; an exposure assessment; a toxicity assessment; and a risk characterization.
24. "Seller's Disclosure" means, pursuant to A.R.S. § 33-434.01, a written notice from the owner of property to the purchaser of the property that the property has been subject to soil remediation pursuant to A.R.S. §§ 49-151 et. seq.
25. "Soil" means dirt or earthen material located between the surface of the land and groundwater.
26. "Solid Waste Management program" means the program described in Title 49, Chapter 4, Article 4 and the rules promulgated thereunder.
27. "Special Waste Management program" means the program described in Title 49, Chapter 4, Article 9 and A.A.C. Title 18, Chapter 8, Article 3.
28. "Voluntary environmental mitigation use restriction" or "VEMUR" means, pursuant to A.R.S. § 49-152(B), a written document, signed by the owner and the Department, and recorded on the chain of title for a particular parcel of real property which indicates that a remediation to less than residential standards has been completed and, unless subsequently canceled, that the property shall not be used for residential purposes in the future.
29. "Water Quality Assurance Revolving Fund" or "WQARF" means the program described in Title 49, Chapter 2, Article 5 and A.A.C. Title 18, Chapter 7, Article 1.
30. "Underground Storage Tank" or "UST" means the program described in Title 49, Chapter 6, Article 1 and A.A.C. Title 18, Chapter 12.

ARTICLE 2. SOIL REMEDIATION STANDARDS

R18-7-201. Definitions

In addition to the definitions provided in A.R.S. §§ 49-151 and 49-152, the following definitions apply in this Article:

1. "Aquifer Protection Program" means the system of requirements prescribed in A.R.S. Title 49, Chapter 2, Article 3 and A.A.C. Title 18, Chapter 9, Article 1.
2. "Background" means a concentration of a naturally occurring contaminant in soils.
3. "Cancer Group" means a category of chemicals listed by a weight-of-evidence assessment by the United States Environmental Protection Agency to evaluate human carcinogenicity. Based on this evaluation, chemicals are placed in 1 of the following categories: A - known human carcinogen; B1 or B2 - probable human carcinogen; C - possible human carcinogen; D - not classified as to human carcinogenicity; and E - evidence of non-carcinogenicity in humans.
4. "Carcinogen" or "carcinogenic" means a contaminant which has a cancer group designation of Class A, B1, B2, or C, but does not include a substance having cancer group designations D or E. The cancer group designation is found in Appendix A to the rule.
5. "Contact" means exposure to a contaminant through ingestion, inhalation, or dermal absorption.
6. "Contaminant" means a substance regulated by the programs listed in R18-7-202(A) or R18-7-202(B).
7. "Department" means the Arizona Department of Environmental Quality.
8. "Deterministic Risk Assessment Methodology" means a site-specific human health risk assessment performed using a specific set of input variables, exposure assumptions, and toxicity criteria, represented by point estimates for each receptor evaluated, which results in a point estimate of risk.
9. "Ecological Community" means an assemblage of populations of different species within a specified location in space and time.
10. "Ecological Receptor" means a specific ecological community, population, or individual organism, protected by federal or state laws and regulations, or a local population which provides an important natural or economic resource, function, and value.
11. "Ecological Risk Assessment" is a scientific evaluation of the probability of an adverse effect to ecological receptors from exposure to specific types and concentrations of contaminants. An ecological risk assessment contains 4 components: identification of potential contaminants; an exposure assessment; a toxicity assessment; and a risk characterization.

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12. "Engineering Control" means a remediation method used to prevent or minimize exposure to contaminants, and includes technologies that reduce the mobility or migration of contaminants.
13. "Excess Lifetime Cancer Risk" means the increased risk of developing cancer above the background cancer occurrence levels due to exposure to contaminants.
14. "Exposure" means contact between contaminants and organisms.
15. "Exposure Pathway" means the course a contaminant takes from a source to an exposed organism. Each exposure pathway includes a source or release from a source, an exposure point, and an exposure route. If the exposure point differs from the source, transport/exposure media (that is, air, water) are also included.
16. "Exposure Point" means a location of potential contact between a contaminant and an organism.
17. "Exposure Route" means the way a contaminant comes into contact with an organism (that is, by ingestion, inhalation, or dermal contact).
18. "Greenfields Pilot Program" means the system of requirements prescribed in Laws 1997, Chapter 296, § 11.
19. "Groundwater" means water in an aquifer as defined in A.R.S. § 49-201(2).
20. "Hazard Index" means the sum of hazard quotients for multiple substances and/or multiple exposure pathways, or the sum of hazard quotients for chemicals acting by a similar mechanism and/or having the same target organ.
21. "Hazardous Waste Management Program" means the system of requirements prescribed in A.R.S. Title 49, Chapter 5, Article 2 and A.A.C. Title 18, Chapter 8, Article 2.
22. "Hazard Quotient" means the value which quantifies non-carcinogenic risk for 1 chemical for 1 receptor population for 1 exposure pathway over a specified exposure period. The hazard quotient is equal to the ratio of a chemical-specific intake to the reference dose.
23. "Imminent and substantial endangerment to the public health or the environment" has the meaning found in A.R.S. § 49-282.02(C)(1).
24. "Institutional control" means a legal or administrative tool or action taken to reduce the potential for exposure to contaminants.
25. "Letter of Completion" means a Departmental statement which indicates whether the property in question has met the soil remediation standards set forth in this Article.
26. "Migrate" or "Migration" means the movement of contaminants from the point of release, emission, discharge, or spillage: through the soil profile; by volatilization from soil to air and subsequent dispersion to air; and by water, wind or other mechanisms.
27. "Non-Residential Site-Specific Remediation Level" means a level of contaminants remaining in soil after remediation which results in a cumulative excess lifetime cancer risk between 1×10^{-6} and 1×10^{-4} and a Hazard Index no greater than 1 based on non-residential exposure assumptions.
28. "Nuisance" means the activities or conditions which may be subject to A.R.S. §§ 49-141 and 49-104(A)(11).
29. "Person" means any public or private corporation, company, partnership, firm, association or society of persons, the federal government and any of its departments or agencies, this state or any of its agencies, departments, political subdivisions, counties, towns, municipal corporations, as well as a natural person.
30. "Population" means an aggregate of individuals of a species within a specified location in space and time.
31. "Probabilistic Risk Assessment Methodology" means a site-specific human health risk assessment performed using probability distributions of input variables and exposure assumptions which take into account the variability and uncertainty of these values, which results in a range or distribution of possible risk estimates.
32. "Reasonable Maximum Exposure" or "RME" means the highest human exposure case that is greater than the average, but is still within the range of possible exposures to humans at a site.
33. "Remediate" or "remediation" has the meaning found in A.R.S. § 49-151(2).
34. "Repository" means the Department's database, established under A.R.S. § 49-152(D), from which the public may view information pertaining to remediation projects for which a Notice of Remediation has been submitted or a Letter of Completion has been issued.
35. "Residential Site-Specific Remediation Level" means a level of contaminants remaining in the soil after remediation which results in a cumulative excess lifetime cancer risk between 1×10^{-6} and 1×10^{-4} and a Hazard Index no greater than 1 based on residential exposure assumptions.
36. "Residential Use" has the meaning found in A.R.S. § 49-151(3).
37. "Site-Specific Human Health Risk Assessment" is a scientific evaluation of the probability of an adverse effect to human health from exposure to specific types and concentrations of contaminants. A site-specific human health risk assessment contains 4 components: identification of potential contaminants; an exposure assessment; a toxicity assessment; and a risk characterization.
38. "Soil" means all earthen materials located between the land surface and groundwater including sediments and unconsolidated accumulations produced by the physical and chemical disintegration of rocks.
39. "Soil Remediation Level" or "SRL" means a pre-determined risk-based standard developed by the Arizona Department of Health Services pursuant to A.R.S. § 49-152(A)(1)(a) and listed in Appendix A.
40. "Solid Waste Management program" means the system of requirements prescribed in A.R.S. Title 49, Chapter 4, Article 4 and the rules adopted under those statutes.
41. "Special Waste Management program" means the system of requirements prescribed in A.R.S. Title 49, Chapter 4, Article 9 and A.A.C. Title 18, Chapter 8, Article 3.
42. "Underground Storage Tank program" or "UST program" means the system of requirements prescribed in A.R.S. Title 49, Chapter 6, Article 1 and A.A.C. Title 18, Chapter 12.
43. "Voluntary Environmental Mitigation Use Restriction" or "VEMUR" means, pursuant to A.R.S. § 49-152(B), a written document, signed by the real property owner and the Department, and recorded with the county recorder on the chain of title for a particular parcel of real property, which indicates that a remediation to a level less protective than residential standards has been completed and, unless subsequently canceled, that the owner agrees to restrict the property to non-residential uses.

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- 44. "Voluntary Remediation Program" means the system of requirements prescribed in A.R.S. § 49-104(A)(17).
- 45. "Water Quality Assurance Revolving Fund" or "WOARF" means the system of requirements prescribed in A.R.S. Title 49, Chapter 2, Article 5 and A.A.C. Title 18, Chapter 7, Article 1.
- 46. "WOARF Voluntary Program" means the system of requirements prescribed in A.R.S. §§ 49-282.05 and 49-285(B).

R18-7-202. Applicability

- A. This Article applies to a person legally required to conduct soil remediation activities under any of the following regulatory programs administered by the Department:
 - 1. The Water Quality Assurance Revolving Fund (WOARF).
 - 2. The Underground Storage Tank (UST) Program.
 - 3. The Hazardous Waste Disposal Program.
 - 4. The Solid Waste Management Program.
 - 5. The Special Waste Management Program.
 - 6. The Aquifer Protection Permit Program.
- B. This Article also applies to a person not legally required to conduct remediation, but who chooses to do so and who requests a close-out document.
- C. This Article applies in addition to any specific requirements of the programs described in Subsection A.
- D. The scope of this Article is limited to soil remediation activities.
- E. This Article applies to remediation activities which are initiated on or after the effective date of this Article.

R18-7-202. Applicability

- A. This Article applies to a person legally required to conduct soil remediation by any of the following regulatory programs administered by the Department:
 - 1. The Aquifer Protection Permit Program.
 - 2. The Hazardous Waste Management Program.
 - 3. The Solid Waste Management Program.
 - 4. The Special Waste Management Program.
 - 5. The Underground Storage Tank Program.
 - 6. The Water Quality Assurance Revolving Fund.
 - 7. Any other program under A.R.S. Title 49 that regulates soil remediation.
- B. This Article also applies to a person who is not legally required to conduct soil remediation, but who chooses to do so under any of the following programs administered by the Department:
 - 1. The Greenfields Pilot Program.
 - 2. The Voluntary Remediation Program.
 - 3. The WOARF Voluntary Program.
- C. The requirements of this Article apply in addition to any specific requirements of the programs described in subsections (A) or (B).
- D. This Article is limited to soil remediation.
- E. A person who is remediating soil at a site which is characterized before the effective date of this Article shall comply with either the Soil Remediation Standards adopted as an interim rule on March 29, 1996 or the Soil Remediation Standards adopted in this Article. A site is considered characterized when the laboratory analytical results of the soil samples delineating the nature, degree, and extent of soil contamination have been received by the person conducting the remediation.
- F. Nothing in this Article limits the Department's authority to establish more stringent soil remediation levels in response to:
 - 1. A nuisance.

- 2. An imminent and substantial endangerment to the public health or the environment.

- G. This Article does not apply to persons remediating soil to numeric soil remediation levels specified in orders of the Director or orders of any Court that have been entered before the effective date of this Article.

R18-7-203. Remediation Standards

When concluded, a soil remediation activity conducted by a person subject to this Article shall remediate soils to the point that the concentration of each contaminant in the soils achieves compliance with one of the following:

- 1. The background concentrations of the contaminant as described in R18-7-204.
- 2. The HBGLs set forth in Appendix A and the remediation processes described in R18-7-205.
- 3. The remediation levels derived from a site-specific risk assessment and the remediation processes described in R18-7-206.

R18-7-203. Remediation Standards

- A. A person subject to this Article shall remediate soil so that any concentration of contaminants remaining in the soil after remediation is less than or equal to 1 of the following:

- 1. The background remediation standards prescribed in R18-7-204.
- 2. The pre-determined remediation standards prescribed in R18-7-205.
- 3. The site-specific remediation standards prescribed in R18-7-206.

- B. A person who conducts a soil remediation based on the standards set forth in R18-7-205 or R18-7-206 shall remediate soil so that any concentration of contaminants remaining in the soil after remediation does not:

- 1. Cause or threaten to cause a violation of Water Quality Standards prescribed in 18 A.A.C. 11. If the remediation level for a contaminant in the soil is not protective of aquifer water quality and surface water quality, the person shall remediate soil to an alternative soil remediation level that is protective of aquifer water quality and surface water quality.
- 2. Exhibit a hazardous waste characteristic of ignitability, corrosivity or reactivity as defined in A.A.C. R18-8-261(A). If the remediation level for a contaminant in the soil results in leaving soils that exhibit a hazardous waste characteristic other than toxicity, the person shall remediate soil to an alternative soil remediation level such that the soil does not exhibit a hazardous waste characteristic other than toxicity.
- 3. Cause or threaten to cause an adverse impact to ecological receptors. If the Department determines that the remediation level for a contaminant in soil may impact ecological receptors based on the existence of ecological receptors and complete exposure pathways, the person shall conduct an ecological risk assessment. If the ecological risk assessment indicates that any concentration of contaminants remaining in the soil after remediation causes or threatens to cause an adverse impact to ecological receptors, the person shall remediate soil to an alternative soil remediation level, derived from the ecological risk assessment, that is protective of ecological receptors.

R18-7-204. Background Concentration Levels

A person may elect to remediate to the background concentration for a contaminant. If the background concentration is greater than the HBGL or greater than a site-specific remediation level determined pursuant to R18-7-206 and background will be used as the

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remediation level, a proper demonstration shall be made to establish a background concentration for the contaminant of concern, and to justify the selection of the remediation concentration. Laboratory analysis of samples shall be performed by a laboratory licensed by the Arizona Department of Health Services. The following factors may be used in establishing background:

1. Site-specific sampling of unaffected soils based on scientifically valid sampling procedures and statistical methods.
2. Site-specific historical information concerning land use.
3. Migration potential.
4. Chemical composition and bio-availability of the contaminant of interest.

R18-7-204. Background Remediation Standards

A. A person may elect to remediate to a background concentration for a contaminant.

B. A person who conducts a remediation to a background concentration for a contaminant shall establish the background concentration using all of the following factors:

1. Site-specific historical information concerning land use.
2. Site-specific sampling of soils unaffected by a release, but having characteristics similar to those of the soils affected by the release.
3. A statistical analysis of the background concentrations using the 95th percentile upper confidence limit.

R18-7-205. Health Based Guidance Levels

A. A person may elect to remediate to the HBGLs set forth in Appendix A, or shall do so where required in an enforcement action duly issued or taken by the Department. HBGLs may be utilized if all of the following conditions are met:

1. The contaminant of concern has an HBGL listed in Appendix A.
2. At the conclusion of remediation, the remaining concentration for the contaminant of concern will not cause or threaten contamination of the groundwater to exceed any Aquifer Water Quality Standard pursuant to R18-11-405 and R18-11-406 at a program-specific point of compliance.
3. At the conclusion of remediation, the remaining concentration for the contaminant of concern will not cause or threaten to cause a violation of the Water Quality Standards pursuant to Title 18, Chapter 11, Article 1.
4. At the conclusion of remediation, the remaining concentration for the contaminant of concern does not exhibit the hazardous waste characteristic of ignitability, corrosivity or reactivity as defined in R18-8-261(A).
5. At the conclusion of remediation, the remediation activity itself or the remaining concentration for the contaminant of concern does not cause a nuisance.
6. Federal law does not require the use of a site-specific risk assessment.
7. Laboratory analysis of samples is performed by a laboratory licensed by the Arizona Department of Health Services under A.R.S. § 36-495 et. seq. and the rules promulgated thereunder.

B. Where the practical quantification limits (PQL) are greater than the residential HBGLs, and residential protection is desired or required, a risk assessment shall be conducted to determine the alternative remediation level.

C. A federal regulatory or statutory contaminant pre-determined standard may be used:

1. If no HBGL exists for a contaminant.
2. For polychlorinated biphenyls (PCBs) regulated pursuant to the Toxic Substances Control Act (40 CFR Part 761).

D. A person conducting an HBGL-based remediation shall remediate to the residential HBGL on any property which is described by one of the following:

1. Currently used for residential purposes.
2. Currently zoned as residential or subject to a pending application to be re-zoned as residential.
3. Currently designated as residential use on an approved master plan.

E. A person conducting an HBGL-based remediation project on non-residential property shall either:

1. Remediate to the residential HBGL.
2. Remediate to the non-residential HBGL and comply with all of the following:
 - a. Record, in accordance with R18-7-207, a VEMUR with the County Recorder in the county in which the property is located. The property shall not be used for residential purposes until the VEMUR is cancelled in accordance with R18-7-207.
 - b. Send to the Department, within 30 days of recording, a copy of the recording described in subparagraph (a).
 - c. Provide, prior to closing on the property, written notice to the purchaser in accordance with A.R.S. § 33-434.01.

F. If the HBGL for a contaminant of concern is not protective of groundwater quality, a person may elect to remediate to an alternative standard which will ensure that the contaminant will not exceed any Aquifer Water Quality Standard pursuant to R18-11-405 and R18-11-406 at a program-specific point of compliance. A scientifically valid demonstration shall be made to evaluate the leachability potential and to establish an alternative remediation level. The scientifically valid demonstration shall include site-specific and contaminant-specific characteristics.

R18-7-205. Pre-Determined Remediation Standards

A. A person may elect to remediate to the residential or non-residential Soil Remediation Levels (SRLs) set forth in Appendix A.

B. A person who conducts an SRL-based remediation shall remediate to the residential SRL on any property where there is residential use at the time remediation is completed.

C. A pre-determined contaminant standard established by federal law or regulation may be used for polychlorinated biphenyl cleanups regulated pursuant to the Toxic Substances Control Act (TSCA) at 40 CFR 761.120 et. seq., however, the Department has no regulatory authority to issue a Letter of Completion in TSCA-regulated cleanups.

R18-7-206. Site-Specific Remediation Levels

A. A person may elect, or shall do so where required in an enforcement action duly issued or taken by the Department, to remediate to the concentration levels determined from a site-specific risk assessment if all of the following conditions are met:

1. At the conclusion of remediation, the remaining concentration for the contaminant of concern will not cause or threaten contamination of the groundwater to exceed any Aquifer Water Quality Standard pursuant to R18-11-405 and R18-11-406 at a program-specific point of compliance.
2. At the conclusion of remediation, the remaining concentration for the contaminant of concern will not cause or threaten to cause a violation of the Water Quality Standards under Title 18, Chapter 11, Article 1.
3. At the conclusion of remediation, the remaining concentration for the contaminant of concern does not exhibit

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- the hazardous waste characteristic of ignitability, corrosivity or reactivity as defined in R18-8-261(A).
4. At the conclusion of remediation, the remediation activity itself or the remaining concentration for the contaminant of concern does not cause a nuisance.
 5. Laboratory analysis of samples is performed by a laboratory licensed by the Arizona Department of Health Services under A.R.S. § 36-495 et. seq. and the rules promulgated thereunder.
- B.** When conducting a site-specific risk assessment, a person shall use either a deterministic methodology, a probabilistic methodology or an alternative methodology commonly accepted in the scientific community. If a probabilistic methodology is used, it shall be no less protective than the 95th percentile upper bound estimate.
- C.** A person conducting a remediation based on the concentration levels determined from a site-specific risk assessment shall remediate to residential protection on any property which is described by one of the following:
1. Currently used for residential purposes.
 2. Currently zoned as residential or subject to a pending application to be rezoned as residential.
 3. Currently designated as residential use on an approved master plan.
- D.** A person conducting a remediation project based on the concentration levels determined from a site-specific risk assessment on non-residential property shall either:
1. Remediate to residential protection.
 2. Remediate to a carcinogenic risk level more protective than 1×10^{-4} , but less protective than residential protection and comply with all of the following:
 - a. Record, in accordance with R18-7-207(A), a VEMUR with the County Recorder in the county in which the property is located. The property shall not be used for residential purposes until the VEMUR is cancelled in accordance with R18-7-207(B).
 - b. Send to the Department, within 30 days of recording, a copy of the recording described in subparagraph (a).
 - c. Provide, prior to closing on the property, written notice to the purchaser in accordance with A.R.S. § 33-434.01.
- E.** The Department may approve an alternative carcinogenic risk level greater than 1×10^{-4} and a non-cancer hazard index of greater than one if it is demonstrated that the site-specific conditions, potential pathways of exposure, and institutional and engineering controls are sufficient to protect human health and the environment. If such Departmental approval is given, property use shall be non-residential and subject to the requirements of paragraph (D)(2) of this section.
- F.** If the remediation level determined from a site-specific risk assessment is not protective of groundwater quality, a person may elect to remediate to an alternative standard which will ensure that groundwater quality will not exceed any Aquifer Water Quality Standard pursuant to R18-11-405 and R18-11-406 at a program-specific point of compliance. A scientifically valid demonstration shall be made to evaluate the leachability potential and to establish an alternative remediation level. The scientifically valid demonstration shall include site-specific and contaminant specific characteristics.

R18-7-206. Site-Specific Remediation Standards

- A.** A person may elect to remediate to a residential or a non-residential site-specific remediation level derived from a site-specific human health risk assessment.

- B.** A person who conducts a remediation to a residential or a non-residential site-specific remediation level shall use 1 of the following site-specific human health risk assessment methodologies:

1. A deterministic methodology. If a deterministic methodology is used, reasonable maximum exposures shall be evaluated for future use scenarios.
2. A probabilistic methodology. If a probabilistic methodology is used, it shall be no less protective than the 95th percentile upper bound estimate of the distribution.
3. An alternative methodology commonly accepted in the scientific community. An alternative methodology is considered accepted in the scientific community if it is published in peer-reviewed literature, such as a professional journal or publication of standards of general circulation, and there is general consensus within the scientific community about the methodology.

- C.** A person who conducts a remediation to a site-specific remediation level shall remediate to the residential site-specific remediation level on any property where there is residential use at the time remediation is completed.

- D.** With prior approval of the Department, a person may achieve the site-specific remediation levels based on the use of institutional and engineering controls. The approval shall be based, in part, on the demonstration that the institutional and engineering controls will be maintained.

- E.** A person conducting a remediation to a residential or a non-residential site-specific remediation level shall remediate the contaminants in soil to a cumulative excess lifetime cancer risk between 1×10^{-6} and 1×10^{-4} and a Hazard Index no greater than 1 taking into account the factors enumerated in this subsection. The person conducting a remediation, and the Department prior to issuing a Letter of Completion, shall select the excess lifetime cancer risk between 1×10^{-6} and 1×10^{-4} based upon the following site-specific factors:

1. The presence of multiple contaminants.
2. The existence of multiple pathways of exposure.
3. The uncertainty of exposure.
4. The sensitivity of the exposed population.
5. Other program-related laws and regulations that may apply.

R18-7-207. Voluntary Environmental Mitigation Use Restriction (VEMUR)

- A.** A person who is required to record a VEMUR in accordance with A.R.S. § 49-152 shall record, with the County Recorder's office where the property is located, a copy of the document set forth in Appendix B. The VEMUR shall be recorded within 30 days after completing remediation and shall be formatted in accordance with A.R.S. § 11-480 and any other specific requirements of the recorder of the jurisdiction. Remediation is considered complete when the analytical results of the samples taken to confirm the remediation level have been received by the person conducting the remediation. An authorized Departmental representative shall sign the VEMUR before it is recorded.

- B.** A person who wishes to cancel a recorded VEMUR as described in A.R.S. § 49-152(F) shall record, with the County Recorder's office where the property is located, a copy of the document set forth in Appendix C. An authorized Departmental representative shall sign the VEMUR cancellation before it is recorded.

- C.** Within 30 days of the date of recording, a person who records a document described in subsection (A) or (B) of this Section shall provide a copy of the recording to the Department.

R18-7-207. Voluntary Environmental Mitigation Use

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Restriction (VEMUR)

- A.** A person who remediates to the non-residential SRL, or to the non-residential site-specific remediation level shall submit the information listed in R18-7-208(A)(1) through (5) and a VEMUR signed by the real property owner, as set forth in Appendix B, to the applicable Departmental program listed in R18-7-202(A) or R18-7-202(B). The VEMUR shall be formatted in accordance with A.R.S. § 11-480 and any other specific requirements of the County Recorder of the jurisdiction.
- B.** The applicable Departmental program listed in R18-7-202(A) or R18-7-202(B) shall evaluate the complete information described in R18-7-207(A) and verify whether the non-residential SRL or the non-residential site-specific remediation level has been achieved. An authorized Departmental representative shall either sign the VEMUR submitted pursuant to subsection (A) of this Section and return the signed VEMUR by certified mail, or request additional information to make the verification.
- C.** A person described in R18-7-207(A) shall record a VEMUR described in R18-7-207(B) with the County Recorder's office where the property is located within 30 calendar days of receipt of the VEMUR signed by the authorized Departmental representative, as evidenced by the return receipt.
- D.** A real property owner who remediates to the background concentration of a contaminant, to the residential SRL, or to the residential site-specific remediation level and who wishes to cancel a recorded VEMUR shall submit the information required in R18-7-208(A)(1) through (5) and a signed VEMUR Cancellation, as set forth in Appendix C, to the applicable Departmental program listed in R18-7-202(A) or R18-7-202(B). The VEMUR Cancellation shall be formatted in accordance with A.R.S. § 11-480 and any other specific requirements of the County Recorder of the jurisdiction.
- E.** The applicable Departmental program listed in R18-7-202(A) or R18-7-202(B) shall evaluate the complete information described in R18-7-207(D) and verify whether the background concentration, the residential SRL, or the residential site-specific remediation level has been achieved. An authorized Departmental representative shall either sign the VEMUR Cancellation submitted pursuant to R18-7-207(D) and return the VEMUR Cancellation via certified mail, or request additional information to make the verification.
- F.** A person who records a document described in R18-7-207 shall provide a copy of the recorded document to the applicable Departmental program described in R18-7-202(A) or R18-7-202(B) within 30 calendar days of the date of recording.
- R18-7-208. Initial Notice, Final Report, and Close-Out Document**
- A.** The requirements of this Section apply in addition to any specific requirements of the programs described in R18-7-202(A). If there is no requirement to remediate, a person who desires to receive a close-out document shall submit an initial notice and a final report.
- B.** A person conducting a remediation project based on predetermined remediation standards or background concentrations shall submit in writing to the Department an initial notice of the intent to remediate which includes the following information:
1. The nature of the remediation project, including all of the following:
 - a. Site location, including the legal description of the property;
 - b. Site characteristics;
 - c. Current and post-remediation property use description as either residential or non-residential;
 - d. The rationale for selection of remediation levels;
 - e. The technologies to be used to remediate the site.
- C.** A person conducting a remediation project based on the concentration levels determined from a site-specific risk assessment shall submit in writing to the Department an initial notice of the intent to remediate and a request for risk assessment methodology approval. Departmental approval is required prior to beginning remediation. The initial notice and request for approval of the risk assessment methodology shall include all of the following information:
1. The site location, including the legal description of the property;
 2. The site characteristics;
 3. Current and post-remediation property use description as either residential or non-residential;
 4. A description of the risk assessment methodology to be used;
 5. The exposure pathway and individual exposure profile assumptions.
- D.** The Department shall take one of the following actions on a request for approval for risk assessment methodology:
1. Approve, deny, or request additional information necessary to make the determination within 45 days of receipt of the request;
 2. Approve, deny, or request additional information necessary to make the determination within a timeframe specified in an existing Departmental regulatory program;
 3. Approve or deny the request within 45 days of receipt of any additional information requested by the Department.
- E.** Within 90 days following completion of remediation activities at a site, or within a timeframe specified in an existing regulatory program administered by the Department, a person described in subsection (B) or © shall submit to the Department a final report of the post-remediation site conditions. A final report shall be a pre-requisite for the Department's consideration of a close-out document. The report shall include all of the following information:
1. A description of the actual activities, techniques and technologies used to remediate the site, including the maintenance of engineering controls;
 2. Consideration of all demonstrations, factors, and conditions described in R18-7-204, R18-7-205, and R18-7-206(A)(1) and all documentation supporting the report's conclusions;
 3. Soil sampling results which are representative of the entire site;
 4. Proof of compliance with local zoning requirements available from the county or city zoning boards;
 5. A statement signed by the owner or a person authorized to act on behalf the owner certifying the following:
I certify under penalty of law that this document and all attachments are to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.
- F.** A final report submitted for non-residential remediation activities shall include the following information in addition to Subsection E:
1. A certification signed by the owner stating awareness of the requirements of A.R.S. §§ 33-434.01 and 49-152.

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- 2. A copy of the VEMUR, as set forth in Appendix B, signed by the Department and recorded with the County Recorder's office.
- G. Within 60 days after receiving a final report, the Department shall issue a close-out document, deny, or request additional information necessary to issue a close-out document.
- H. The Department may require additional investigation including any necessary additional remediation, and may revoke, amend, or reaffirm any decision made under this Section if the information is incomplete or inaccurate, or if any condition was unknown to the Department when the Department entered into a decision under this Section.

R18-7-208. Letter of Completion

- A. If a person requests a Letter of Completion, a person shall submit, at a minimum, the following information to the applicable Departmental program listed in R18-7-202(A) or R18-7-202(B):
 - 1. A description of the actual activities, techniques, and technologies used to remediate soil at the site, including the legal mechanism in place to ensure that any institutional and engineering controls are maintained.
 - 2. Documentation that requirements prescribed in R18-7-203(A) and R18-7-203(B)(1) and (2) have been satisfied.
 - 3. If the Department determines pursuant to R18-7-203(B)(3) that an ecological risk assessment is required, documentation that the requirements prescribed in R18-7-203(B)(3) have been satisfied.
 - 4. Soil sampling analytical results which are representative of the area which has been remediated, including documentation that the laboratory analysis of samples has been performed by a laboratory licensed by the Arizona Department of Health Services under A.R.S. § 36-495 et seq. and 9 A.A.C. 14, Article 6.
 - 5. A statement signed by the person conducting the remediation certifying the following:
I certify under penalty of law that this document and all attachments are, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of a fine and imprisonment for knowing violations.
- B. The applicable Departmental program described in R18-7-202(A) or R18-7-202(B) shall evaluate the information described in R18-7-208(A) and R18-7-207(F) to verify compliance with the soil remediation standards set forth under this Article and shall issue a Letter of Completion or request additional information.
- C. The applicable Departmental program listed in R18-7-202(A) or R18-7-202(B) may revoke or amend any Letter of Completion if any of the information submitted pursuant to R18-7-208(A) and R18-7-207(F) is inaccurate or if any condition was unknown to the Department when the Department issued the Letter of Completion.

R18-7-209. Public Access to Information

- A. Pursuant to A.R.S. § 49-152(D), the Department shall establish and maintain an information registry for sites for which an initial notice of remediation has been filed. In addition, the registry shall contain a listing of those sites being remediated under programs administered by the Department or remediated pursuant to a Departmental enforcement action. Each entry in the registry shall contain all of the following:
 - 1. The name and address of the property owner.
 - 2. The dates the remediation was initiated and completed.
 - 3. A legal description and street address of the property.

- 4. An indication of whether residential protection has been achieved and whether the provisions of A.R.S. §§ 49-152(B) and 33-434.01 apply.

- 5. Each contaminant that has been remediated.

- 6. Such other information as is reasonably necessary to implement the statutory mandate.

- B. Material in the Registry shall be available for public inspection during the Department's normal business hours. A person who wishes to obtain copies of Registry materials may do so after paying an appropriate copying fee as established by the Department. In addition, the Department shall periodically provide a list of sites from the Registry to each local jurisdiction in which a site is located.

R18-7-209. Notice of Remediation and Repository

- A. A person conducting soil remediation shall submit a Notice of Remediation to the applicable Departmental program listed in R18-7-202(A) or R18-7-202(B) prior to beginning remediation. A person conducting a soil remediation during an emergency who has notified the Department in accordance with emergency notification requirements prescribed in A.R.S. § 49-284 is not required to submit a Notice of Remediation. Any person who continues or initiates a soil remediation after the initial emergency response shall submit a Notice of Remediation. A Notice of Remediation shall include all of the following information:
 - 1. The name and address of the real property owner;
 - 2. The name and address of the remediating party;
 - 3. A legal description and street address of the property;
 - 4. A list of each contaminant to be remediated;
 - 5. The background concentration, SRL, or site-specific remediation level selected to meet the remediation standards;
 - 6. A description of the current and post-remediation property use as either residential or non-residential;
 - 7. The rationale for the selection of residential or non-residential remediation; and
 - 8. The proposed technologies for remediating the site.
- B. The Department shall establish and maintain a repository for information regarding sites where soil is remediated. The Repository shall include a listing of sites for which a Notice of Remediation has been submitted or a Letter of Completion has been issued.
 - 1. For sites where a Notice of Remediation has been filed, the Repository shall contain the date the notice was filed and the information submitted as described in R18-7-209(A).
 - 2. For sites where a Letter of Completion has been issued, the Repository shall contain the following:
 - a. The name and address of the real property owner;
 - b. The name and address of the remediating party;
 - c. A legal description and street address of the property;
 - d. A listing of each contaminant that was remediated;
 - e. The background concentration, SRL, or site-specific remediation level selected to meet the remediation standard;
 - f. A description whether the residential or non-residential standard was achieved;
 - g. A description of any engineering or institutional control used to remediate the site; and
 - h. The date when the Letter of Completion was issued.
 - 3. The Repository will be available for public review during the Department's normal business hours. A person

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who wishes to obtain copies of the Repository shall pay a copying fee established by the Department.

APPENDIX A
HUMAN HEALTH BASED GUIDANCE LEVELS (HBGLS)
FOR INGESTION OF CONTAMINATION IN SOIL
 June 1995 Update

Chemical	Cas Number	Cancer Group	Soil Ingestion	
			Residential Oral HBGL (mg/kg)	Non-Res Oral HBGL (mg/kg)
A				
1. Acenaphthene	83-32-9	ND	7000.0	24500.0
2. »Acenaphthylene (PAH)	208-96-8	D	7000.0	24500.0
3. »Acephate	30560-19-1	C	160.0	560.0
4. Acetochlor	34256-82-1	NA	2300.0	8050.0
5. »Acetone	67-64-1	D	12000.0	42000.0
6. Acetonitrile	75-05-8	ND	700.0	2450.0
7. Acetophenone	98-86-2	D	12000.0	42000.0
8. Acifluorfen	62476-59-9	ND	1500.0	5250.0
9. »Aerolein	107-02-8	C	2300.0	8050.0
10. »Acrylamide	79-06-1	B2	0.3	1.3
11. Acrylic acid	79-10-7	NA	58000.0	203000.0
12. »Acrylonitrile	107-13-1	B1	2.5	10.5
13. »Alachlor	15972-60-8	B2	17.0	71.0
14. Alar	1596-84-5	NA	18000.0	63000.0
15. »Aldicarb	116-06-3	D	120.0	420.0
16. »Aldicarb-sulfone	1646-88-4	D	120.0	420.0
17. »Aldicarb-sulfoxide	1646-87-3	D	150.0	525.0
18. »Aldrin	309-00-2	B2	0.08	0.34
19. Allyl alcohol	107-18-6	NA	580.0	2030.0
20. Allyl chloride	107-05-1	C	5800.0	20300.0
21. Aluminum phosphide	20859-73-8	NA	47.0	165.0
22. Amdro	67485-29-4	ND	35.0	123.0
23. »Ametryn	834-12-8	D	1100.0	3850.0
24. Aminopyridine	504-24-5	D	2.3	8.0
25. Amitraz	33089-61-1	ND	290.0	1015.0
26. Ammonia (NH3)	7664-41-7	D	120000.0	420000.0
27. »Ammonium sulfamate	7773-06-0	D	23000.0	80500.0
28. Aniline	62-53-3	B2	240.0	1008.0
29. »Anthracene (PAH)	120-12-7	D	35000.0	122500.0
30. »Antimony (Sb)	7440-36-0	D	47.0	165.0
31. Apollo	74115-24-5	C	150.0	525.0
32. Aramite	140-57-8	B2	54.0	227.0
33. »Arsenic, inorganic (As)	7440-38-2	A	0.91	3.82
34. Assure	76578-14-8	D	1100.0	3850.0
35. »Asulam	3337-71-1	D	5800.0	20300.0
36. »Atrazine	1912-24-9	C	6.1	21.4
37. Avermectin-b1	65195-55-3	ND	47.0	165.0
38. »Azinphos-methyl	86-50-0	E	290.0	1015.0
39. Azobenzene	103-33-3	B2	12.0	50.0
B				
40. »Barium (Ba)	7440-39-3	D	8200.0 ##	28700.0 ##
41. Barium cyanide	542-62-1	ND	12000.0	42000.0
42. Baythroid	68359-37-5	ND	2900.0	10150.0
43. Benefin	1861-40-1	NA	35000.0	122500.0
44. »Benomyl	17804-35-2	D	5800.0	20300.0
45. »Bentazon	25057-89-0	D	290.0	1015.0

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46. Benzaldehyde	100-52-7	NA	12000.0	42000.0
47. »Benz[a]anthracene (PAH)	56-55-3	B2	1.1	4.6
48. »Benzene (BNZ)	71-43-2	A	47.0	197.0
49. »Benzidine	92-87-5	A	0.006	0.025
50. »Benzo[a]pyrene (PAH) (BaP)	50-32-8	B2	0.19	0.80
51. »Benzo[b]fluoranthene (PAH)	205-99-2	B2	1.1	4.6
52. »Benzo[k]fluoranthene (PAH)	207-08-9	B2	1.1	4.6
53. Benzoic acid	65-85-0	D	470000.0	1645000.0
54. Benzotrichloride	98-07-7	B2	0.1	0.4
55. »Benzyl alcohol	100-51-6	ND	35000.0	122500.0
56. Benzyl chloride	100-44-7	B2	8.0	34.0
57. »Beryllium (Be)	7440-41-7	B2	0.32	1.34
58. Bidrin	141-66-2	NA	12.0	42.0
59. Biphenyl	2657-04-3	NA	1800.0	6300.0
60. 1,1-Biphenyl	92-52-4	D	5800.0	20300.0
61. »bis(2-chloroethyl) ether (BCEE)	111-44-4	B2	1.2	5.0
62. »Bis(2-chloroisopropyl) ether	39638-32-9	ND	19.0	67.0
63. bis(chloromethyl) ether (BCME)	542-88-1	A	0.006	0.025
64. Bisphenol A	80-05-7	NA	5800.0	20300.0
65. »Boron and borates only (B)	7440-42-8	D	11000.0	38500.0
66. »Bromacil	314-40-9	E	1500.0	5250.0
67. »Bromodichloromethane (THM) (BDCM)	75-27-4	B2	22.0	92.0
68. »Bromoform (THM) (BRFM)	75-25-2	B2	170.0	714.0
69. »Bromomethane (BMM)	74-83-9	D	160.0	560.0
70. »Bromoxynil	1689-84-5	D	2300.0	8050.0
71. Bromoxynil octanoate	1689-99-2	NA	2300.0	8050.0
72. N-butanol	71-36-3	D	12000.0	42000.0
73. »Butyl benzyl phthalate	85-68-7	E	2300.0	8050.0
74. »Butylate	2008-41-5	D	5800.0	20300.0
75. Butylphthalyl butylglycolate	85-70-1	NA	120000.0	420000.0

C

76. Cacodylic acid	75-60-5	D	350.0	1225.0
77. »Cadmium (Cd)	7440-43-9	B1	58.0	244.0
78. Calcium cyanide	592-01-8	ND	4700.0	16450.0
79. Caprolactam	105-60-2	NA	58000.0	203000.0
80. Captafol	2425-06-1	ND	160.0	560.0
81. »Captan	133-06-2	D	390.0	1365.0
82. »Carbaryl	63-25-2	D	12000.0	42000.0
83. »Carbofuran	1563-66-2	E	580.0	2030.0
84. »Carbon disulfide	75-15-0	D	12000.0	42000.0
85. »Carbon tetrachloride (CCL4)	56-23-5	B2	10.0	42.0
86. Carbosulfan	55285-14-8	ND	1200.0	4200.0
87. »Carboxin	5234-68-4	D	12000.0	42000.0
88. Chloral	75-87-6	NA	230.0	805.0
89. »Chloramben	133-90-4	D	1800.0	6300.0
90. »Chlordane	57-74-9	B2	1.0	4.0
91. »Chlordimeform	6164-98-3	B2	1.2	5.0
92. Chlorimuron ethyl	90982-32-4	NA	2300.0	8050.0
93. Chlorine cyanide	506-77-4	ND	5800.0	20300.0
94. p-Chloroaniline	106-47-8	NA	470.0	1645.0
95. »Chlorobenzene (monochlorobenzene) (MCB)	108-90-7	D	2300.0	8050.0
96. Chlorobenzilate	510-15-6	B2	5.0	21.0
97. 1-Chlorobutane	109-69-3	D	47000.0	164500.0
98. »Chloroform (THM) (CLFM)	67-66-3	B2	220.0	924.0
99. »Chloromethane (CM)	74-87-3	E	100.0	350.0
100. beta-Chloronaphthalene	91-58-7	NA	9400.0	32900.0
101. »2-Chlorophenol	95-57-8	D	580.0	2030.0
102. »Chlorothalonil	1897-45-6	B2	120.0	504.0
103. »o-Chlorotoluene	95-49-8	D	2300.0	8050.0
104. Chlorpropham	101-21-3	NA	23000.0	80500.0
105. »Chlorpyrifos	2921-88-2	D	350.0	1225.0
106. Chlorpyrifos methyl	5598-13-0	NA	1200.0	4200.0
107. »Chlorsulfuron	64902-72-3	D	5800.0	20300.0
108. Chromium(III)	16065-83-1	NA	120000.0	420000.0

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109. Chromium(VI)	18540-29-9	A	580.0	2436.0
110. Chromium(VI) (CrVI)	7440-47-3	A	580.0	2436.0
111. »Chromium(Total) (Cr)	NA	D	1700.0##	5950.0##
112. »Chrysene (PAH)	218-01-9	B2	110.0	462.0
113. »Copper (Cu)	7440-50-8	D	4300.0##	15050.0##
114. Copper-cyanide	544-92-3	ND	580.0	2030.0
115. »Cresols (total)	NA	D	5800.0	20300.0
116. Crotonaldehyde	123-73-9	C	0.72	2.52
117. Cumene	98-82-8	NA	4700.0	16450.0
118. »Cyanazine	21725-46-2	D	1.6	5.6
119. »Cyanide (Cn)	57-12-5	D	2300.0	8050.0
120. Cyanogen	460-19-5	ND	4700.0	16450.0
121. Cyanogen-bromide	506-68-3	ND	11000.0	38500.0
122. Cyclohexanone	108-94-1	NA	580000.0	2030000.0
123. Cyclohexylamine	108-91-8	NA	23000.0	80500.0
124. Cyhalothrin (Karate)	68085-85-8	ND	580.0	2030.0
125. Cypermethrin	52315-07-8	ND	1200.0	4200.0
126. »Cyromazine	66215-27-8	D	880.0	3080.0

D

127. »2,4-D (2,4-dichlorophenoxy)ac	94-75-7	D	1200.0	4200.0
128. »Dalapon	75-99-0	D	3500.0	12250.0
129. Danitol	39515-41-8	ND	2900.0	10150.0
130. »DCEPA (dimethyl tetrachloroer	1861-32-1	D	1200.0	4200.0
131. »DDD (p,p'-dichlorodiphenyldie (DDD)	72-54-8	B2	5.7	23.9
132. »DDE (p,p'-dichlorodiphenyldie (DDE)	72-55-9	B2	4.0	17.0
133. »DDT (p,p'-dichlorodiphenyltri (DDT)	50-29-3	B2	4.0	17.0
134. »DDT/DDD/DDE (total) (DDT)	NA	B2	4.0	17.0
135. Decabromodiphenyl ether	1163-19-5	C	1200.0	4200.0
136. Demeton	8065-48-3	NA	4.7	16.5
137. 2,4-Diaminotoluene	95-80-7	NA	0.43	1.51
138. »Diazinon	333-41-5	E	110.0	385.0
139. »Dibenz[a,h]anthracene (PAH)	53-70-3	B2	0.11	0.46
140. 1,4-Dibromobenzene	106-37-6	NA	1200.0	4200.0
141. »Dibromochloromethane (THM) (DBCM)	124-48-1	C	16.0	56.0
142. »1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	B2	0.97	4.07
143. »Dibutyl phthalate	84-74-2	D	12000.0	42000.0
144. »Dicamba	918-00-9	D	3500.0	12250.0
145. »Dichlobenil	1194-65-6	D	58.0	203.0
146. »1,2-Dichlorobenzene (DCB2)	95-50-1	D	11000.0	38500.0
147. »1,3-Dichlorobenzene (DCB3)	541-73-1	D	10000.0	350.0
148. »1,4-Dichlorobenzene (DCB4)	106-46-7	C	57.0	200.0
149. »3,3'-dichlorobenzidine	91-94-1	B2	3.0	13.0
150. »Dichlorodifluoromethane (DCDFM)	75-71-8	D	23000.0	80500.0
151. 1,1-Dichloroethane (DCA)	75-34-3	C	1200.0	4200.0
152. »1,2-Dichloroethane (DCA2)	107-06-2	B2	15.0	63.0
153. »1,1-Dichloroethylene (DCE)	75-35-4	C	2.3	8.0
154. 1,2-Dichloroethylene (DCE2)	540-59-0	D	2300.0	8050.0
155. 1,2-Dichloroethylene (TOTAL)	NA	D	1200.0	4200.0
156. »cis-1,2-Dichloroethylene	156-59-2	D	1200.0	4200.0
157. »trans-1,2-Dichloroethylene	156-60-5	D	2300.0	8050.0
158. »Dichloromethane (DCM)	75-09-2	B2	180.0	756.0
159. 4-(2,4-Dichlorophenoxy)butyric acid	94-82-6	NA	940.0	3290.0
160. »2,4-Dichlorophenol	120-83-2	D	350.0	1225.0
161. »1,2-Dichloropropane (DCP2)	78-87-5	B2	20.0	84.0
162. 2,3-Dichloropropanol	616-23-9	ND	350.0	1225.0
163. »1,3-Dichloropropene	542-75-6	B2	7.6	31.9
164. Dichlorvos	62-73-7	B2	4.7	19.7
165. »Dielorin	99-30-9	E	2900.0	10150.0
166. »Diofol	115-32-2	C	3.1**	13.0**
167. »Dioldrin	60-57-1	B2	0.09	0.38
168. »Diethyl phthalate	84-66-2	D	94000.0	329000.0
169. »Di(2-ethylhexyl) adipate	103-23-1	C	1100.0	3850.0
170. »Di(2-ethylhexyl) Phthalate (DEHP)	117-81-7	B2	97.0	407.0
171. »Difenzoquat	43222-48-6	D	9400.0	32900.0

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172: Diflubenzuron	35367-38-5	ND	2300.0	8050.0
173: »Diisopropyl Methylphosphonate (DIMP)	1445-75-6	D	9400.0	32900.0
174: Dimethipin	55290-64-7	E	230.0	805.0
175: »Dimethoate	60-51-5	D	23.0	81.0
176: Dimethyl phthalate	131-11-3	D	1200000.0	4200000.0
177: Dimethyl sulfate	77-78-1	B2	0.04	0.17
178: Dimethyl terephthalate	120-61-6	NA	12000.0	42000.0
179: N,N-Dimethylaniline	121-69-7	NA	230.0	805.0
180: 1,2-Dimethylbenzene (Xylene-o)	95-47-6	ND	230000.0	805000.0
181: 1,3-Dimethylbenzene (Xylene-m)	108-38-3	ND	230000.0	805000.0
182: 1,4-Dimethylbenzene (Xylene-p)	106-42-3	ND	230000.0	805000.0
183: 3,3-Dimethylbenzidine	119-93-7	NA	0.15	0.53
184: N,N-dimethylformamide	68-12-2	ND	12000.0	42000.0
185: 1,1-Dimethylhydrazine	57-14-7	NA	0.52	1.82
186: 2,4-Dimethylphenol	105-67-9	NA	2300.0	8050.0
187: 2,6-Dimethylphenol	576-26-1	ND	70.0	245.0
188: 3,4-Dimethylphenol	95-65-8	NA	120.0	420.0
189: o-dinitrobenzene	528-29-0	D	47.0	165.0
190: m-dinitrobenzene	99-65-0	D	12.0	42.0
191: 4,6-Dinitro-o-cyclohexyl-phenol	131-89-5	NA	230.0	805.0
192: »2,4-dinitrophenol	51-28-5	ND	230.0	805.0
193: »2,4-dinitrotoluene	121-14-2	B2	2.0	8.0
194: 2,6-dinitrotoluene	606-20-2	ND	120.0	420.0
195: »Dinoseb	88-85-7	D	120.0	420.0
196: Diethylphthalate	117-84-0	ND	2300.0	8050.0
197: »1,4-dioxane	123-91-1	B2	120.0	504.0
198: »Diphenamid	957-51-7	D	3500.0	12250.0
199: Diphenylamine	122-39-4	NA	2900.0	10150.0
200: »1,2-diphenylhydrazine	122-66-7	B2	1.7	7.1
201: »Diquat dibromide	85-00-7	D	260.0	910.0
202: Direct black 38	1937-37-7	NA	0.16	0.56
203: Direct blue-6	2602-46-2	NA	0.17	0.60
204: Direct brown-95	16071-86-6	NA	0.15	0.53
205: »Disulfoton	298-04-4	E	4.7	16.5
206: Dithiane	505-29-3	D	1200.0	4200.0
207: »Diuron	330-54-1	D	230.0	805.0
208: Dodine	2439-10-3	ND	470.0	1645.0
209: »Dpx-m6316 (thifensulfuron-met	79277-27-3	ND	1500.0	5250.0

E

210: »Endosulfan	115-29-7	D	700.0	2450.0
211: »Endosulfan-i	959-988	D	5.8	20.3
212: »Endothall	145-73-3	D	2300.0	8050.0
213: »Endrin	72-20-8	D	35.0	123.0
214: »Epichlorohydrin	106-89-8	B2	140.0	588.0
215: »Ethephon	16672-87-0	D	580.0	2030.0
216: »Epte-(s-ethyl dipropylthioear-(EPTC)	759-94-4	D	2900.0	10150.0
217: Ethion	563-12-2	ND	58.0	203.0
218: 2-Ethoxyethanol	110-80-5	NA	47000.0	164500.0
219: Ethyl acetate	141-78-6	NA	110000.0	385000.0
220: Ethyl acrylate	140-88-5	NA	28.0	98.0
221: Ethyl ether	60-29-7	ND	23000.0	80500.0
222: Ethyl methacrylate	97-63-2	NA	11000.0	38500.0
223: Ethyl p-nitrophenyl phenylphosphorothioat	2104-64-5	NA	1.2	4.2
224: »Ethylbenzene (ETB)	100-41-4	D	12000.0	42000.0
225: Ethylene diamine	107-15-3	D	2300.0	8050.0
226: »Ethylene dibromide (EDB)	106-93-4	B2	0.02	0.08
227: »Ethylene glycol	107-21-1	D	230000.0	805000.0
228: »Ethylene thiourea (ETU)	96-45-7	B2	12.0	50.0
229: Ethylphthalyl ethylglycolate	84-72-0	NA	350000.0	1225000.0
230: »N-ethyltoluene-sulfonamide	26914-52-3	ND	290.0	1015.0
231: Express	101200-48-0	NA	940.0	3290.0

F

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232. »Fenamiphos	22224-92-6	D	29.0	102.0
233. »Fenarimol	60168-88-9	E	7600.0	26600.0
234. »Fenvalerate	51630-58-1	ND	2900.0	10150.0
235. »Fluometuron	2164-17-2	D	1500.0	5250.0
236. »Fluoranthene (PAH)	206-44-0	D	4700.0	16450.0
237. »Fluorene (PAH)	86-73-7	D	4700.0	16450.0
238. »Fluoride (F)	7782-41-4	D	7000.0	24500.0
239. »Fluridone	59756-60-4	D	9400.0	32900.0
240. Flurprimidol	56425-91-3	ND	2300.0	8050.0
241. Flutolanil	66332-96-5	ND	7000.0	24500.0
242. »Fluralinate	69409-94-5	D	1200.0	4200.0
243. Felpet	133-07-3	B2	390.0	1638.0
244. Fomesafen	72178-02-0	C	7.2	25.2
245. »Fonofos	944-22-9	D	230.0	805.0
246. Formaldehyde	50-00-0	B1	23000.0	96600.0
247. »Formetanate hydrochloride	23422-53-9	E	180.0	630.0
248. Formic acid	64-18-6	ND	230000.0	805000.0
249. »Fosetyl-al	39148-24-8	C	35000.0	122500.0
250. Furan	110-00-9	NA	120.0	420.0
251. Furfural	98-01-1	NA	350.0	1225.0
252. Furmeeyelox	60568-05-0	B2	45.0	189.0

G

253. Glufosinate-ammonium	77182-82-2	NA	47.0	165.0
254. Glycidaldehyde	765-34-4	B2	47.0	197.0
255. »Glyphosate	1071-83-6	D	12000.0	42000.0

H

256. Haloxypop-methyl	69806-40-2	ND	5.8	20.3
257. »Heptachlor	76-44-8	B2	0.3	1.3
258. »Heptachlor-epoxide	1024-57-3	B2	0.15	0.63
259. Hexabromobenzene	87-82-1	NA	230.0	805.0
260. »Hexachlorobenzene	118-74-1	B2	0.85	3.57
261. »Hexachlorobutadiene	87-68-3	C	17.0	60.0
262. »alpha-Hexachlorocyclohexane (alpha-HCH)	319-84-6	B2	0.22	0.92
263. »beta-Hexachlorocyclohexane (beta-HCH)	319-85-7	C	0.76 **	3.19 **
264. Technical-hexachlorocyclohexa	608-73-1	B2	0.76	3.19
265. »Hexachlorocyclopentadiene (HCCPD)	77-47-4	D	820.0	2870.0
266. Hexachlorodibenzo-p-dioxin, mixture	19408-74-3	B2	0.0002	0.0008
267. »Hexachloroethane	67-72-1	C	97.0	340.0
268. Hexachlorophene	70-30-4	NA	35.0	123.0
269. »n-hexane	110-54-3	D	7000.0	24500.0
270. »Hexazinone	51235-04-2	D	3900.0	13650.0
271. Hebenearb	28249-77-6	ND	1200.0	4200.0
272. »HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-Tetrazocine)	2691-41-0D	D	5800.0	20300.0
273. Hydrazine	302-01-2	B2	0.45	1.89
274. Hydrogen-cyanide	74-90-8	ND	2300.0	8050.0
275. Hydrogen-sulfide	7783-06-4	NA	350.0	1225.0
276. Hydroquinone	123-31-9	NA	4700.0	16450.0

I

277. »Imazalil	35554-44-0	D	1500.0	5250.0
278. »Imazaquin	81335-37-7	D	29000.0	101500.0
279. »Indenopyrene (PAH)	193-39-5	B2	1.1	4.6
280. Iprodione	36734-19-7	ND	4700.0	16450.0
281. Isobutyl-alcohol	78-83-1	NA	35000.0	122500.0
282. »Isophorone	78-59-1	C	1400.0	4900.0
283. Isopropalin	33820-53-0	ND	1800.0	6300.0
284. Isopropyl-methyl-phosphonic-acid	1832-54-8	D	12000.0	42000.0
285. Isoxaben	82558-50-7	C	5800.0	20300.0

L

286. Laetofen	77501-63-4	NA	230.0	805.0
287. »Lead and compounds (inorganic) (Pb)	7439-92-1	B2	400.0 ##	1400.0 ##
288. »Lindane (gamma-hexachlorocycl (gamma-HCH)	58-89-9	C	1.0	4.0

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289. »Linuron	330-55-2	C	23.0	81.0
290. Londax	83055-99-6	NA	23000.0	80500.0
M				
291. »Malathion	121-75-5	D	2300.0	8050.0
292. Maleic anhydride	108-31-6	NA	12000.0	42000.0
293. »Maleic hydrazide	123-33-1	D	58000.0	203000.0
294. »Mancozeb	8018-01-7	ND	3500.0	12250.0
295. »Maneb	12427-38-2	D	580.0	2030.0
296. »Manganese (Mn)	7439-96-5	D	580.0	2030.0
297. »MCPA (2-methyl-4-chlorophenoxy (MCPA)	94-74-6	D	58.0	203.0
298. »Mepiquat chloride	24307-26-4	D	3500.0	12250.0
299. »Mercury (inorganic) (Hg)	7439-97-6	D	35.0	123.0
300. Merphos	150-50-5	NA	3.5	12.3
301. Merphos-oxide	78-48-8	NA	3.5	12.3
302. »Metolachlor	57837-19-1	D	7000.0	24500.0
303. Methacrylonitrile	126-98-7	NA	12.0	42.0
304. »Methamidophos	10265-92-6	D	5.8	20.3
305. Methanol	67-56-1	ND	58000.0	203000.0
306. Methidathion	950-37-8	C	120.0	420.0
307. »Methiocarb	2032-65-7	E	150.0	525.0
308. »Methomyl	16752-77-5	D	2900.0	10150.0
309. »Methoxychlor	72-43-5	D	580.0	2030.0
310. 2-Methoxyethanol	109-86-4	NA	120.0	420.0
311. Methyl acetate	79-20-9	NA	120000.0	420000.0
312. 2-(2-Methyl-4-chlorophenoxy)propionic acid	93-65-2	NA	120.0	420.0
313. 4-(2-Methyl-4-chlorophenoxy)butyric acid	94-81-5	NA	1200.0	4200.0
314. »Methyl ethyl ketone (MEK)	78-93-3	D	70000.0	245000.0
315. Methyl isobutyl ketone	108-10-1	NA	9400.0	32900.0
316. Methyl mercury	22967-92-6	C	12.0	42.0
317. Methyl methacrylate	80-62-6	NA	9400.0	32900.0
318. »Methyl parathion	298-00-0	D	29.0	102.0
319. »Methyl tert-butyl ether (MTBE)	1634-04-4	D	580.0	2030.0
320. 4,4'-Methylene dianiline	101-77-9	NA	5.4	18.9
321. 4,4'-Methylene bis(N,N'-dimethyl)aniline	101-61-1	B2	30.0	126.0
322. 2-Methylacetonitrile	75-86-5	NA	8200.0	28700.0
323. 2-Methylphenol (o-Cresol)	95-48-7	C	580.0	2030.0
324. 3-Methylphenol (m-Cresol)	108-39-4	C	580.0	2030.0
325. 4-methylphenol	106-44-5	C	580.0	2030.0
326. »Metolachlor	51218-45-2	C	1800.0	6300.0
327. »Metribuzin	21087-64-9	D	2900.0	10150.0
328. »Metsulfuron-methyl	74223-64-6	D	29000.0	101500.0
329. Mirex	2385-85-5	ND	0.76	2.66
330. Molinate	2212-67-1	ND	230.0	805.0
331. »Molybdenum	7439-98-7	D	580.0	2030.0
332. Monochloramine	10599-90-3	D	12000.0	42000.0
333. »Monocrotophos	6923-22-4	E	5.3	18.6
334. Monomethylhydrazine	60-34-4	NA	1.2	4.2
335. »Monuron	150-68-5	ND	82.0	287.0
336. »Msma (monosodium-methanearson	2163-80-6	A	840.0 ##	3528.0 ##
337. »Myelobutanil	88671-89-0	ND	2900.0	10150.0
N				
338. »Naled	300-76-5	D	230.0	805.0
339. »Naphthalene (PAH)	91-20-3	D	4700.0	16450.0
340. »Napropamide	15299-99-7	ND	12000.0	42000.0
341. »Nickel, soluble salts (Ni)	7440-02-0	D	2300.0	8050.0
342. »Nitrate (NO3)	14797-55-8	D	190000.0	665000.0
343. »Nitrate/Nitrite (total)	NA	D	190000.0	665000.0
344. Nitric oxide	10102-43-9	NA	12000.0	42000.0
345. »Nitrite	14797-65-0	D	12000.0	42000.0
346. 2-Nitroaniline	88-74-4	NA	7.0	25.0
347. »Nitrobenzene	98-95-3	D	58.0	203.0
348. Nitrogen dioxide	10102-44-0	NA	120000.0	420000.0
349. »Nitroguanidine	556-88-7	D	12000.0	42000.0

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350. N-Nitroso-di-n-butylamine	924-16-3	B2	0.25	1.05
351. »n-Nitroso-di-n-propylamine	621-64-7	B2	0.19	0.80
352. n-Nitroso-diethylamine	55-18-5	B2	0.009	0.038
353. »n-Nitroso-dimethylamine	62-75-9	B2	0.03	0.13
354. »n-Nitroso-diphenylamine	86-30-6	B2	280.0	1176.0
355. N-Nitroso-N-ethylurea	759-73-9	B2	0.01	0.04
356. N-Nitroso-N-methylethylamine	10595-95-6	B2	0.06	0.25
357. N-Nitrosodiethanolamine	1116-54-7	B2	0.49	2.06
358. »n-Nitrosopyrrolidine	930-55-2	B2	0.65	2.73
359. »Norflurazon	27314-13-2	D	4700.0	16450.0
360. NuStar	85509-19-9	NA	82.0	287.0

O

361. Octabromodiphenyl ether	32536-52-0	D	350.0	1225.0
362. Octamethylpyrophosphoramidate	152-16-9	NA	230.0	805.0
363. »Oryzalin	19044-88-3	E	580.0	2030.0
364. Oxadiazon	19666-30-9	NA	580.0	2030.0
365. »Oxamyl	23135-22-0	E	2900.0	10150.0
366. »Oxydemeton-methyl	301-12-2	D	58.0	203.0
367. Oxyfluorfen	42874-03-3	ND	350.0	1225.0

P

368. Paeolobutrazol	76738-62-0	NA	1500.0	5250.0
369. »Paraquat	1910-42-5	E	53.0	186.0
370. »Parathion	56-38-2	E	70.0	245.0
371. »Pendimethalin	40487-42-1	D	4700.0	16450.0
372. Pentabromodiphenyl ether	32534-81-9	D	230.0	805.0
373. »Pentachlorobenzene	608-93-5	D	94.0	329.0
374. Pentachloronitrobenzene	82-68-8	NA	5.2	18.2
375. »Pentachlorophenol	87-86-5	B2	11.0	46.0
376. »Permethrin	52645-53-1	D	5800.0	20300.0
377. Phenmedipham	13684-63-4	NA	29000.0	101500.0
378. »Phenol	108-95-2	D	70000.0	245000.0
379. m-Phenylenediamine	108-45-2	NA	700.0	2450.0
380. Phenylmercuric acetate	62-38-4	ND	9.4	32.9
381. »Phorate	298-02-2	E	23.0	81.0
382. »Phosmet	732-11-6	D	2300.0	8050.0
383. »Phosphamidon	13171-21-6	D	20.0	70.0
384. Phosphine	7803-51-2	D	35.0	123.0
385. Phthalic anhydride	85-44-9	NA	230000.0	805000.0
386. »Pictoram	1918-02-1	D	8200.0	28700.0
387. Pirimiphos-methyl	29232-93-7	ND	1200.0	4200.0
388. »Polychlorinated biphenyls (PCBs)	1336-36-3	B2	0.18	0.76
389. Polychlorinated biphenyl-ar	12674-11-2	ND	8.2	28.7
390. Potassium cyanide	151-50-8	NA	5800.0	20300.0
391. Potassium silver cyanide	506-61-6	ND	23000.0	80500.0
392. Prochloraz	67747-09-5	E	9.1	31.9
393. »Profenofos	41198-08-7	D	5.8	20.3
394. »Profluralin	26399-36-0	ND	700.0	2450.0
395. »Prometon	1610-18-0	D	1800.0	6300.0
396. »Prometryn	7287-19-6	D	470.0	1645.0
397. »Pronamide	23950-58-5	E	880.0	3080.0
398. »Propachlor	1918-16-7	D	1500.0	5250.0
399. Propanil	709-98-8	ND	580.0	2030.0
400. »Propargite	2312-35-8	ND	2300.0	8050.0
401. Propargyl alcohol	107-19-7	NA	230.0	805.0
402. »Propazine	139-40-2	E	230.0	805.0
403. »Propham	122-42-9	D	2300.0	8050.0
404. »Propiconazole	60207-90-1	D	1500.0	5250.0
405. »Propoxur	114-26-1	E	47.0	165.0
406. Propylene glycol	57-55-6	ND	2300000.0	8050000.0
407. Propylene glycol monoethyl ether	52125-53-8	ND	82000.0	287000.0
408. Propylene glycol monomethyl ether	107-98-2	NA	82000.0	287000.0
409. Propylene oxide	75-56-9	B2	5.7	23.9.0
410. Pursuit	81335-77-5	NA	29000.0	101500.0

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411. »Pyrene (PAH)	129-00-0	D	3500.0	12250.0
412. Pyridine	110-86-1	NA	120.0	420.0
Q				
413. Quinalphos	13593-03-8	NA	58.0	203.0
414. Quinoline	91-22-5	NA	0.11	0.39
R				
415. »RDX (hexahydro-1,3,5-trinitro (RDX))	121-82-4	G	12.0	42.0
416. Resmethrin	10453-86-8	NA	3500.0	12250.0
417. Ronnel	299-84-3	NA	5800.0	20300.0
418. Rotenone	83-79-4	NA	470.0	1645.0
S				
419. Savey	78587-05-0	NA	2900.0	10150.0
420. Selenious acid	7783-00-8	D	580.0	2030.0
421. »Selenium and compounds (Se)	7782-49-2	D	580.0 ##	2030.0 ##
422. Selenourea	630-10-4	ND	580.0	2030.0
423. »Sethoxydim	74051-80-2	D	11000.0	38500.0
424. »Silver (Ag)	7440-22-4	D	580.0	2030.0
425. Silver-cyanide	506-64-9	ND	12000.0	42000.0
426. »Simazine	122-34-9	G	11.0	39.0
427. Sodium azide	26628-22-8	ND	470.0	1645.0
428. Sodium-cyanide	143-33-9	NA	4700.0	16450.0
429. Sodium-diethyldithiocarbamate	148-18-5	NA	5.0	18.0
430. Sodium-fluoroacetate	62-74-8	ND	2.3	8.0
431. »Strontium	7440-24-6	D	70000.0	245000.0
432. Strychnine	57-24-9	ND	35.0	123.0
433. »Styrene	100-42-5	G	2300.0	8050.0
434. »Sulfate (SO4)	14808-79-8	D	6700000.0 ##	23450000.0 ##
435. »Sulprofos	35400-43-2	E	290.0	1015.0
T				
436. »2,3,7,8-TCDD (TCDD)	1746-01-6	B2	0.000009	0.000038
437. »Tebuthiuron	34014-18-1	D	8200.0	28700.0
438. »Terbacil	5902-51-2	E	1500.0	5250.0
439. »Terbufos	13071-79-9	D	2.9	10.2
440. »Terbutryn	886-50-0	ND	120.0	420.0
441. »1,2,4,5-Tetrachlorobenzene	95-94-3	D	35.0	123.0
442. »1,1,1,2-Tetrachloroethane	630-20-6	G	52.0	182.0
443. »1,1,2,2-Tetrachloroethane (TET)	79-34-5	G	6.8 **	28.6 **
444. »Tetrachloroethylene (PCE)	127-18-4	B2	27.0	113.0
445. 2,3,4,6-tetrachlorophenol	58-90-2	ND	3500.0	12250.0
446. Tetrachlorovinphos	961-11-5	NA	57.0	200.0
447. »Tetraethyl lead	78-00-2	D	0.01	0.04
448. Tetraethyldithiopyrophosphate	3689-24-5	ND	58.0	203.0
449. Thallie oxide	1314-32-5	D	8.2	28.7
450. »Thallium (Tl)	7440-28-0	ND	8.2	28.7
451. Thallium acetate	563-68-8	D	11.0	39.0
452. Thallium carbonate	6533-73-9	D	9.4	32.9
453. Thallium chloride	7791-12-0	D	9.4	32.9
454. Thallium nitrate	10102-45-1	D	11.0	39.0
455. Thallium selenite	12039-52-0	D	11.0	39.0
456. Thallium sulfate	7446-18-6	D	9.4	32.9
457. Thiofanox	39196-18-4	NA	35.0	123.0
458. »Thiophanate-methyl	23564-05-8	D	9400.0	32900.0
459. Thiophenol	108-98-5	NA	1.2	4.2
460. »Thiram	137-26-8	D	580.0	2030.0
461. Tin (Sn)	NA	ND	70000.0	245000.0
462. »Toluene (TOL)	108-88-3	D	23000.0	80500.0
463. Total petroleum hydrocarbons (TPH)	NA	ND	7000.0 su	24500.0 su
464. »Toxaphene	8001-35-2	B2	1.2	5.0
465. Tralomethrin	66841-25-6	ND	880.0	3080.0
466. »Triadimefen	43121-43-3	D	3500.0	12250.0
467. Triallate	2303-17-5	ND	1500.0	5250.0

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468. Triasulfuron	82097-50-5	NA	1200.0	4200.0
469. 1,2,4-Tribromobenzene	615-54-3	ND	580.0	2030.0
470. Tributyltin oxide	56-35-9	ND	3.5	12.3
471. »Trichlorfen	52-68-6	C	150.0	525.0
472. »1,2,4-Trichlorobenzene	120-82-1	D	1200.0	4200.0
473. »1,1,1-Trichloroethane (TCA)	71-55-6	D	11000.0	38500.0
474. »1,1,2-Trichloroethane (TCA2)	79-00-5	C	24.0	84.0
475. »Trichloroethylene (TCE)	79-01-6	B2	120.0	504.0
476. »Trichlorofluoromethane (TCFM)	75-69-4	D	35000.0	122500.0
477. »2,4,5-Trichlorophenol	95-95-4	D	12000.0	42000.0
478. »2,4,6-Trichlorophenol	88-06-2	B2	120.0	504.0
479. »2,4,5-T (2,4,5-trichloropheno	93-76-5	D	1200.0	4200.0
480. »2,4,5-TP (2 (2,4,5-TrichloroPhenoxy) Propionic acid)	93-72-1	D	940.0	3290.0
481. 1,1,2-Trichloropropane	598-77-6	ND	580.0	2030.0
482. »1,2,3-Trichloropropane	96-18-4	D	0.19	0.67
483. »Trichlorotrifluoroethane (F113)	76-13-1	D	3500000.0	12250000.0
484. »Triclopyr	55335-06-3	E	290.0	1015.0
485. Tridiphane	58138-08-2	ND	350.0	1225.0
486. »Trifluralin	1582-09-8	C	180.0	630.0
487. »Triforine	26644-46-2	D	2900.0	10150.0
488. 1,3,5-Trinitrobenzene	99-35-4	NA	5.8	20.3
489. »2,4,6-Trinitrotoluene (TNT)	118-96-7	C	45.0	158.0
U				
490. »Uranium (U)	7440-61-1	A	350.0-xx	1225.0-xx
V				
491. »Vanadium (V)	7440-62-2	D	820.0	2870.0
492. Vanadium pentoxide	1314-62-1	NA	1100.0	3850.0
493. »Vernolate	1929-77-7	ND	120.0	420.0
494. »Vinclozolin	50471-44-8	D	2900.0	10150.0
495. Vinyl acetate	108-05-4	NA	120000.0	420000.0
496. »Vinyl chloride (VC)	75-01-4	A	0.72	3.02
W				
497. Warfarin	81-81-2	NA	35.0	123.0
498. White phosphorus	7723-14-0	D	2.3	8.0
X				
499. »Xylenes (total) (XYL)	1330-20-7	D	230000.0	805000.0
Z				
500. »Zinc and compounds (Zn)	7440-66-6	D	35000.0	122500.0
501. Zinc cyanide	557-21-1	ND	5800.0	20300.0
502. Zinc phosphide	1314-84-7	NA	35.0	123.0
503. »Zineb	12122-67-7	D	5800.0	20300.0

» Chemicals requested by DEQ

TF Treatment Technology

NA Not Available

ND Not Determined

su Based on Surrogate RfD

xx

xx

##

no RfD, HBGL based on Slope

no SLOPE FACTOR, based on RfD

HBGL not based on RfD or SLOPE FACTOR
(If Lead, based on EPA biokinetic)

APPENDIX A

SOIL REMEDIATION LEVELS (SRLs)

<u>Chemical</u>	<u>Cas Number</u>	<u>Cancer Group</u>	<u>Residential (mg/k)</u>	<u>Non Residential (mg/k)</u>
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A

1	<u>Acenaphthene</u>	<u>83-32-9</u>	D	<u>3900.0</u>	<u>41000.0</u>
2	<u>Acephate</u>	<u>30560-19-1</u>	C	<u>260.0</u>	<u>2200.0</u>
3	<u>Acetaldehyde</u>	<u>75-07-0</u>	B2	<u>39.0</u>	<u>150.0</u>
4	<u>Acetochlor</u>	<u>34256-82-1</u>	D	<u>1300.0</u>	<u>14000.0</u>
5	<u>Acetone</u>	<u>67-64-1</u>	D	<u>2100.0</u>	<u>8800.0</u>
6	<u>Acetone cyanohydrin</u>	<u>75-86-5</u>	D	<u>52.0</u>	<u>550.0</u>
7	<u>Acetonitrile</u>	<u>75-05-8</u>	D	<u>220.0</u>	<u>1200.0</u>
8	<u>Acetophenone</u>	<u>98-86-2</u>	D	<u>0.49</u>	<u>1.6</u>
9	<u>Acifluorfen</u>	<u>62476-59-9</u>	D	<u>850.0</u>	<u>8900.0</u>
10	<u>Acrolein</u>	<u>107-02-8</u>	C	<u>0.10</u>	<u>0.34</u>
11	<u>Acrylamide</u>	<u>79-06-1</u>	B2	<u>0.98</u>	<u>4.2</u>
12	<u>Acrylic acid</u>	<u>79-10-7</u>	D	<u>31000.0</u>	<u>290000.0</u>
13	<u>Acrylonitrile</u>	<u>107-13-1</u>	B1	<u>1.9</u>	<u>4.7</u>
14	<u>Alachlor</u>	<u>15972-60-8</u>	B2	<u>55.0</u>	<u>240.0</u>
15	<u>Alar</u>	<u>1596-84-5</u>	D	<u>9800.0</u>	<u>100000.0</u>
16	<u>Aldicarb</u>	<u>116-06-3</u>	D	<u>65.0</u>	<u>680.0</u>
17	<u>Aldicarb sulfone</u>	<u>1646-88-4</u>	D	<u>65.0</u>	<u>680.0</u>
18	<u>Aldrin</u>	<u>309-00-2</u>	B2	<u>0.26</u>	<u>1.1</u>
19	<u>Allyl</u>	<u>5585-64-8</u>	D	<u>16000.0</u>	<u>170000.0</u>
20	<u>Allyl alcohol</u>	<u>107-18-6</u>	D	<u>330.0</u>	<u>3400.0</u>
21	<u>Allyl chloride</u>	<u>107-05-1</u>	C	<u>3200.0</u>	<u>33000.0</u>
22	<u>Aluminum</u>	<u>7429-90-5</u>	D	<u>77000.0</u>	<u>1000000.0</u>
23	<u>Aluminum phosphide</u>	<u>20859-73-8</u>	D	<u>31.0</u>	<u>680.0</u>
24	<u>Amdro</u>	<u>67485-29-4</u>	D	<u>20.0</u>	<u>200.0</u>
25	<u>Ametryn</u>	<u>834-12-8</u>	D	<u>590.0</u>	<u>6100.0</u>
26	<u>m-Aminophenol</u>	<u>591-27-5</u>	D	<u>4600.0</u>	<u>48000.0</u>
27	<u>4-Aminopyridine</u>	<u>504-24-5</u>	D	<u>1.3</u>	<u>14.0</u>
28	<u>Amitraz</u>	<u>33089-61-1</u>	D	<u>160.0</u>	<u>1700.0</u>
29	<u>Ammonia</u>	<u>7664-41-7</u>	D	<u>2200.0</u>	<u>58000.0</u>
30	<u>Ammonium sulfamate</u>	<u>7773-06-0</u>	D	<u>13000.0</u>	<u>140000.0</u>
31	<u>Aniline</u>	<u>62-53-3</u>	B2	<u>19.0</u>	<u>200.0</u>
32	<u>Anthracene</u>	<u>120-12-7</u>	D	<u>20000.0</u>	<u>200000.0</u>
33	<u>Antimony and compounds</u>	<u>7440-36-0</u>	D	<u>31.0</u>	<u>680.0</u>
34	<u>Antimony pentoxide</u>	<u>1314-60-9</u>	D	<u>38.0</u>	<u>850.0</u>
35	<u>Antimony potassium tartrate</u>	<u>28300-74-5</u>	D	<u>69.0</u>	<u>1500.0</u>
36	<u>Antimony tetroxide</u>	<u>1332-81-6</u>	D	<u>31.0</u>	<u>680.0</u>
37	<u>Antimony trioxide</u>	<u>1309-64-4</u>	D	<u>31.0</u>	<u>680.0</u>
38	<u>Apollo</u>	<u>74115-24-5</u>	C	<u>850.0</u>	<u>8900.0</u>
39	<u>Aramite</u>	<u>140-57-8</u>	B2	<u>180.0</u>	<u>760.0</u>
40	<u>~Arsenic</u>	<u>7440-38-2</u>	A	<u>10.0</u>	<u>10.0</u>
41	<u>Assure</u>	<u>76578-12-6</u>	D	<u>590.0</u>	<u>6100.0</u>
42	<u>Asulam</u>	<u>3337-71-1</u>	D	<u>3300.0</u>	<u>34000.0</u>
43	<u>Atrazine</u>	<u>1912-24-9</u>	C	<u>20.0</u>	<u>86.0</u>
44	<u>Avermectin B1</u>	<u>65195-55-3</u>	D	<u>26.0</u>	<u>270.0</u>
45	<u>Azobenzene</u>	<u>103-33-3</u>	B2	<u>40.0</u>	<u>170.0</u>

B

46	<u>Barium and compounds</u>	<u>7440-39-3</u>	D	<u>5300.0</u>	<u>110000.0</u>
47	<u>Barium cyanide</u>	<u>542-62-1</u>	D	<u>7700.0</u>	<u>170000.0</u>
48	<u>Baygon</u>	<u>114-26-1</u>	D	<u>260.0</u>	<u>2700.0</u>
49	<u>Bayleton</u>	<u>43121-43-3</u>	D	<u>2000.0</u>	<u>20000.0</u>
50	<u>Baythroid</u>	<u>68359-37-5</u>	D	<u>1600.0</u>	<u>17000.0</u>
51	<u>Benefin</u>	<u>1861-40-1</u>	D	<u>20000.0</u>	<u>200000.0</u>
52	<u>Benomyl</u>	<u>17804-35-2</u>	D	<u>3300.0</u>	<u>34000.0</u>
53	<u>Bentazon</u>	<u>25057-89-0</u>	D	<u>160.0</u>	<u>1700.0</u>
54	<u>Benzaldehyde</u>	<u>100-52-7</u>	D	<u>6500.0</u>	<u>68000.0</u>
55	<u>Benz[a]anthracene</u>	<u>56-55-3</u>	B2	<u>6.1</u>	<u>26.0</u>
56	<u>Benzene</u>	<u>71-43-2</u>	A	<u>0.62</u>	<u>1.4</u>
57	<u>Benzydine</u>	<u>92-87-5</u>	A	<u>0.0019</u>	<u>0.0083</u>
58	<u>Benzo[a]pyrene</u>	<u>50-32-8</u>	B2	<u>0.61</u>	<u>2.6</u>
59	<u>Benzo[b]fluoranthene</u>	<u>205-99-2</u>	B2	<u>6.1</u>	<u>26.0</u>
60	<u>Benzoic acid</u>	<u>65-85-0</u>	D	<u>260000.0</u>	<u>1000000.0</u>

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61	<u>Benzo[k]fluoranthene</u>	<u>207-08-9</u>	B2	<u>61.0</u>	<u>260.0</u>
62	<u>Benotrichloride</u>	<u>98-07-7</u>	B2	<u>0.34</u>	<u>1.5</u>
63	<u>Benzyl alcohol</u>	<u>100-51-6</u>	D	<u>20000.0</u>	<u>200000.0</u>
64	<u>Benzyl chloride</u>	<u>100-44-7</u>	B2	<u>8.0</u>	<u>20.0</u>
65	<u>Beryllium and compounds</u>	<u>7440-41-7</u>	B2	<u>1.4</u>	<u>11.0</u>
66	<u>Bidrin</u>	<u>141-66-2</u>	D	<u>6.5</u>	<u>68.0</u>
67	<u>Biphenethrin (Talstar)</u>	<u>82657-04-3</u>	D	<u>980.0</u>	<u>10000.0</u>
68	<u>1,1-Biphenyl</u>	<u>92-52-4</u>	D	<u>3300.0</u>	<u>34000.0</u>
69	<u>Bis(2-chloroethyl)ether</u>	<u>111-44-4</u>	B2	<u>0.43</u>	<u>0.97</u>
70	<u>Bis(2-chloroisopropyl)ether</u>	<u>39638-32-9</u>	C	<u>25.0</u>	<u>67.0</u>
71	<u>Bis(chloromethyl)ether</u>	<u>542-88-1</u>	A	<u>0.0002</u>	<u>0.0004</u>
72	<u>Bis(2-chloro-1-methylethyl)ether</u>	<u>108-60-1</u>	C	<u>63.0</u>	<u>270.0</u>
73	<u>Bis(2-ethylhexyl)phthalate (DEHP)</u>	<u>117-81-7</u>	B2	<u>320.0</u>	<u>1400.0</u>
74	<u>Bisphenol A</u>	<u>80-05-7</u>	D	<u>3300.0</u>	<u>34000.0</u>
75	<u>Boron</u>	<u>7440-42-8</u>	D	<u>5900.0</u>	<u>61000.0</u>
76	<u>Bromodichloromethane</u>	<u>75-27-4</u>	B2	<u>6.3</u>	<u>14.0</u>
77	<u>Bromoform (tribromomethane)</u>	<u>75-25-2</u>	B2	<u>560.0</u>	<u>2400.0</u>
78	<u>Bromomethane</u>	<u>74-83-9</u>	D	<u>6.8</u>	<u>23.0</u>
79	<u>Bromophos</u>	<u>2104-96-3</u>	D	<u>330.0</u>	<u>3400.0</u>
80	<u>Bromoxynil</u>	<u>1689-84-5</u>	D	<u>1300.0</u>	<u>14000.0</u>
81	<u>Bromoxynil octanoate</u>	<u>1689-99-2</u>	D	<u>1300.0</u>	<u>14000.0</u>
82	<u>1,3-Butadiene</u>	<u>106-99-0</u>	B2	<u>0.064</u>	<u>0.14</u>
83	<u>1-Butanol</u>	<u>71-36-3</u>	D	<u>6500.0</u>	<u>68000.0</u>
84	<u>Butylate</u>	<u>2008-41-5</u>	D	<u>3300.0</u>	<u>34000.0</u>
85	<u>Butyl benzyl phthalate</u>	<u>85-68-7</u>	C	<u>13000.0</u>	<u>140000.0</u>
86	<u>Butylphthalyl butylglycolate</u>	<u>85-70-1</u>	D	<u>65000.0</u>	<u>680000.0</u>

C

87	<u>Cacodylic acid</u>	<u>75-60-5</u>	D	<u>200.0</u>	<u>2000.0</u>
88	<u>Cadmium and compounds</u>	<u>7440-43-9</u>	B1	<u>38.0</u>	<u>850.0</u>
89	<u>Calcium cyanide</u>	<u>592-01-8</u>	D	<u>3100.0</u>	<u>68000.0</u>
90	<u>Caprolactam</u>	<u>105-60-2</u>	D	<u>33000.0</u>	<u>340000.0</u>
91	<u>Captafol</u>	<u>2425-06-1</u>	C	<u>130.0</u>	<u>1400.0</u>
92	<u>Captan</u>	<u>133-06-2</u>	D	<u>1300.0</u>	<u>5500.0</u>
93	<u>Carbaryl</u>	<u>63-25-2</u>	D	<u>6500.0</u>	<u>68000.0</u>
94	<u>Carbazole</u>	<u>86-74-8</u>	B2	<u>220.0</u>	<u>950.0</u>
95	<u>Carbofuran</u>	<u>1563-66-2</u>	E	<u>330.0</u>	<u>3400.0</u>
96	<u>Carbon disulfide</u>	<u>75-15-0</u>	D	<u>7.5</u>	<u>24.0</u>
97	<u>Carbon tetrachloride</u>	<u>56-23-5</u>	B2	<u>1.6</u>	<u>5.0</u>
98	<u>Carbosulfan</u>	<u>55285-14-8</u>	D	<u>650.0</u>	<u>6800.0</u>
99	<u>Carboxin</u>	<u>5234-68-4</u>	D	<u>6500.0</u>	<u>68000.0</u>
100	<u>Chloral</u>	<u>302-17-0</u>	D	<u>130.0</u>	<u>1400.0</u>
101	<u>Chloramben</u>	<u>133-90-4</u>	D	<u>980.0</u>	<u>10000.0</u>
102	<u>Chloranil</u>	<u>118-75-2</u>	C	<u>11.0</u>	<u>47.0</u>
103	<u>Chlordane</u>	<u>57-74-9</u>	B2	<u>3.4</u>	<u>15.0</u>
104	<u>Chlorimuron-ethyl</u>	<u>90982-32-4</u>	D	<u>1300.0</u>	<u>14000.0</u>
105	<u>Chlorine cyanide</u>	<u>506-77-4</u>	D	<u>3800.0</u>	<u>85000.0</u>
106	<u>Chloroacetic acid</u>	<u>79-11-8</u>	D	<u>130.0</u>	<u>1400.0</u>
107	<u>2-Chloroacetophenone</u>	<u>532-27-4</u>	D	<u>0.56</u>	<u>5.9</u>
108	<u>4-Chloroaniline</u>	<u>106-47-8</u>	D	<u>260.0</u>	<u>2700.0</u>
109	<u>Chlorobenzene</u>	<u>108-90-7</u>	D	<u>65.0</u>	<u>220.0</u>
110	<u>Chlorobenzilate</u>	<u>510-15-6</u>	B2	<u>16.0</u>	<u>71.0</u>
111	<u>p-Chlorobenzoic acid</u>	<u>74-11-3</u>	D	<u>13000.0</u>	<u>140000.0</u>
112	<u>4-Chlorobenzotrifluoride</u>	<u>98-56-6</u>	D	<u>1300.0</u>	<u>14000.0</u>
113	<u>2-Chloro-1,3-butadiene</u>	<u>126-99-8</u>	D	<u>3.6</u>	<u>12.0</u>
114	<u>1-Chlorobutane</u>	<u>109-69-3</u>	D	<u>710.0</u>	<u>2400.0</u>
115	<u>* 1-Chloro-1,1-difluoroethane</u>	<u>75-68-3</u>	D	<u>2800.0</u>	<u>2800.0</u>
116	<u>* Chlorodifluoromethane</u>	<u>75-45-6</u>	D	<u>2800.0</u>	<u>2800.0</u>
117	<u>Chloroform</u>	<u>67-66-3</u>	B2	<u>2.5</u>	<u>5.3</u>
118	<u>Chloromethane</u>	<u>74-87-3</u>	C	<u>12.0</u>	<u>26.0</u>
119	<u>4-Chloro-2-methylaniline</u>	<u>95-69-2</u>	B2	<u>7.7</u>	<u>33.0</u>
120	<u>4-Chloro-2-methylaniline hydrochloride</u>	<u>3165-93-3</u>	B2	<u>9.7</u>	<u>41.0</u>
121	<u>beta-Chloronaphthalene</u>	<u>91-58-7</u>	D	<u>5200.0</u>	<u>55000.0</u>
122	<u>o-Chloronitrobenzene</u>	<u>88-73-3</u>	B2	<u>180.0</u>	<u>760.0</u>
123	<u>p-Chloronitrobenzene</u>	<u>100-00-5</u>	B2	<u>250.0</u>	<u>1100.0</u>

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124	2-Chlorophenol	95-57-8	D	91.0	370.0
125	2-Chloropropane	75-29-6	D	170.0	580.0
126	Chlorothalonil	1897-45-6	B2	400.0	1700.0
127	* o-Chlorotoluene	95-49-8	D	160.0	550.0
128	Chlorpropham	101-21-3	D	13000.0	140000.0
129	Chlorpyrifos	2921-88-2	D	200.0	2000.0
130	Chlorpyrifos-methyl	5598-13-0	D	650.0	6800.0
131	Chlorsulfuron	64902-72-3	D	3300.0	34000.0
132	Chlorthiophos	602-38-56-4	D	52.0	550.0
133	Chromium, Total (1/6 ratio Cr VI/Cr III)	N/A	D	2100.0	4500.0
134	Chromium III	16065-83-1	D	77000.0	1000000.0
135	Chromium VI	7440-47-3	A	30.0	64.0
136	Chrysene	218-01-9	B2	610.0	2600.0
137	Cobalt	7440-48-4	D	4600.0	97000.0
138	Copper and compounds	7440-50-8	D	2800.0	63000.0
139	Copper cyanide	544-92-3	D	380.0	8500.0
140	Crotonaldehyde	123-73-9	C	0.052	0.11
141	Cumene	98-82-8	D	19.0	62.0
142	Cyanazine	21725-46-2	D	5.3	23.0
143	Cyanide, Free	57-12-5	D	1300.0	14000.0
144	Cyanogen	460-19-5	D	2600.0	27000.0
145	Cyanogen bromide	506-68-3	D	5900.0	61000.0
146	Cyanogen chloride	506-77-4	D	3300.0	34000.0
147	Cyclohexanone	108-94-1	D	330000.0	1000000.0
148	Cyclohexylamine	108-91-8	D	13000.0	140000.0
149	Cyhalothrin/Karate	68085-85-8	D	330.0	3400.0
150	Cypermethrin	52315-07-8	D	650.0	6800.0
151	Cyromazine	66215-27-8	D	490.0	5100.0

D

152	Dacthal	1861-32-1	D	650.0	6800.0
153	Dalapon	75-99-0	D	2000.0	20000.0
154	Danitol	39515-41-8	D	1600.0	17000.0
155	DDD	72-54-8	B2	19.0	80.0
156	DDE	72-55-9	B2	13.0	56.0
157	DDT	50-29-3	B2	13.0	56.0
158	Decabromodiphenyl ether	1163-19-5	C	650.0	6800.0
159	Demeton	8065-48-3	D	2.6	27.0
160	Diallate	2303-16-4	B2	73.0	310.0
161	Diazinon	333-41-5	E	59.0	610.0
162	Dibenz[ah]anthracene	53-70-3	B2	0.61	2.6
163	Dibenzofuran	132-64-9	D	260.0	2700.0
164	1,4-Dibromobenzene	106-37-6	D	650.0	6800.0
165	Dibromochloromethane	124-48-1	C	53.0	230.0
166	1,2-Dibromo-3-chloropropane	96-12-8	B2	3.2	14.0
167	1,2-Dibromoethane	106-93-4	B2	0.049	0.2
168	Dibutyl phthalate	84-74-2	D	6500.0	68000.0
169	Dicamba	1918-00-9	D	2000.0	20000.0
170	* 1,2-Dichlorobenzene	95-50-1	D	1100.0	3900.0
171	* 1,3-Dichlorobenzene	541-73-1	D	500.0	2000.0
172	1,4-Dichlorobenzene	106-46-7	C	190.0	790.0
173	3,3-Dichlorobenzidine	91-94-1	B2	9.9	42.0
174	1,4-Dichloro-2-butene	764-41-0	B2	0.074	0.17
175	Dichlorodifluoromethane	75-71-8	D	94.0	310.0
176	1,1-Dichloroethane	75-34-3	C	500.0	1700.0
177	1,2-Dichloroethane	107-06-2	B2	2.5	5.5
178	1,1-Dichloroethylene	75-35-4	C	0.36	0.8
179	1,2-Dichloroethylene (cis)	156-59-2	D	31.0	100.0
180	1,2-Dichloroethylene (trans)	156-60-5	D	78.0	270.0
181	1,2-Dichloroethylene (mixture)	540-59-0	D	35.0	120.0
182	2,4-Dichlorophenol	120-83-2	D	200.0	2000.0
183	4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)	94-82-6	D	520.0	5500.0
184	2,4-Dichlorophenoxyacetic Acid (2,4-D)	94-75-7	D	650.0	6800.0
185	1,2-Dichloropropane	78-87-5	B2	3.1	6.8

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186	1,3-Dichloropropene	542-75-6	B2	2.4	5.5
187	2,3-Dichloropropanol	616-23-9	D	200.0	2000.0
188	Dichlorvos	62-73-7	B2	15.0	66.0
189	Dicofol	115-32-2	C	10.0	43.0
190	Dieldrin	60-57-1	B2	0.28	1.2
191	Diethylene glycol, monobutyl ether	112-34-5	D	370.0	3900.0
192	Diethylene glycol, monoethyl ether	111-90-0	D	130000.0	1000000.0
193	Diethylformamide	617-84-5	D	720.0	7500.0
194	Di(2-ethylhexyl)adipate	103-23-1	C	3700.0	16000.0
195	Diethyl phthalate	84-66-2	D	52000.0	550000.0
196	Diethylstilbestrol	56-53-1	A	0.0001	0.0004
197	Difenzoquat (Avenge)	43222-48-6	D	5200.0	55000.0
198	Diflubenzuron	35367-38-5	D	1300.0	14000.0
199	Diisopropyl methylphosphonate	1445-75-6	D	5200.0	55000.0
200	Dimethipin	55290-64-7	C	1300.0	14000.0
201	Dimethoate	60-51-5	D	13.0	140.0
202	3,3'-Dimethoxybenzidine	119-90-4	B2	320.0	1400.0
203	Dimethylamine	124-40-3	D	0.07	0.24
204	N-N-Dimethylaniline	121-69-7	D	130.0	1400.0
205	2,4-Dimethylaniline	95-68-1	C	5.9	25.0
206	2,4-Dimethylaniline hydrochloride	21436-96-4	C	7.7	33.0
207	3,3'-Dimethylbenzidine	119-93-7	B2	0.48	2.1
208	1,1-Dimethylhydrazine	57-14-7	B, C	1.7	7.3
209	1,2-Dimethylhydrazine	540-73-8	B2	0.12	0.52
210	N,N-Dimethylformamide	68-12-2	D	6500.0	68000.0
211	2,4-Dimethylphenol	105-67-9	D	1300.0	14000.0
212	2,6-Dimethylphenol	576-26-1	D	39.0	410.0
213	3,4-Dimethylphenol	95-65-8	D	65.0	680.0
214	Dimethyl phthalate	131-11-3	D	650000.0	1000000.0
215	Dimethyl terephthalate	120-61-6	D	6500.0	68000.0
216	4,6-Dinitro-o-cyclohexyl phenol	131-89-5	D	130.0	1400.0
217	1,3-Dinitrobenzene	99-65-0	D	6.5	68.0
218	1,2-Dinitrobenzene	528-29-0	D	26.0	270.0
219	1,4-Dinitrobenzene	100-25-4	D	26.0	270.0
220	2,4-Dinitrophenol	51-28-5	D	130.0	1400.0
221	Dinitrotoluene mixture	25321-14-6	B2	6.5	28.0
222	2,4-Dinitrotoluene	121-14-2	B2	130.0	1400.0
223	2,6-Dinitrotoluene	606-20-2	D	65.0	680.0
224	Dinoseb	88-85-7	D	65.0	680.0
225	di-n-Octyl phthalate	117-84-0	D	1300.0	14000.0
226	1,4-Dioxane	123-91-1	B2	400.0	1700.0
227	Diphenamid	957-51-7	D	2000.0	20000.0
228	Diphenylamine	122-39-4	D	1600.0	17000.0
229	1,2-Diphenylhydrazine	122-66-7	B2	5.6	24.0
230	Diquat	85-00-7	D	140.0	1500.0
231	Direct black 38	1937-37-7	A	0.052	0.22
232	Direct blue 6	2602-46-2	A	0.055	0.24
233	Direct brown 95	16071-86-6	A	0.048	0.21
234	Disulfoton	298-04-4	E	2.6	27.0
235	1,4-Dithiane	505-29-3	D	650.0	6800.0
236	Diuron	330-54-1	D	130.0	1400.0
237	Dodine	2439-10-3	D	260.0	2700.0

E

238	Endosulfan	115-29-7	D	390.0	4100.0
239	Endothall	145-73-3	D	1300.0	14000.0
240	Endrin	72-20-8	D	20.0	200.0
241	Epichlorohydrin	106-89-8	B2	7.5	25.0
242	1,2-Epoxybutane	106-88-7	D	370.0	3900.0
243	EPTC (S-Ethyl dipropylthiocarbamate)	759-94-4	D	1600.0	17000.0
244	Ethephon (2-chloroethyl phosphonic acid)	16672-87-0	D	330.0	3400.0
245	Ethion	563-12-2	D	33.0	340.0
246	2-Ethoxyethanol	110-80-5	D	26000.0	270000.0
247	2-Ethoxyethanol acetate	111-15-9	D	20000.0	200000.0
248	* Ethyl acetate	141-78-6	D	18000.0	39000.0

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249	<u>Ethyl acrylate</u>	<u>140-88-5</u>	<u>B2</u>	<u>2.1</u>	<u>4.5</u>
250	<u>* Ethylbenzene</u>	<u>100-41-4</u>	<u>D</u>	<u>1500.0</u>	<u>2700.0</u>
251	<u>Ethylene cyanohydrin</u>	<u>109-78-4</u>	<u>D</u>	<u>20000.0</u>	<u>200000.0</u>
252	<u>Ethylene diamine</u>	<u>107-15-3</u>	<u>D</u>	<u>1300.0</u>	<u>14000.0</u>
253	<u>Ethylene glycol</u>	<u>107-21-1</u>	<u>D</u>	<u>130000.0</u>	<u>1000000.0</u>
254	<u>Ethylene glycol, monobutyl ether</u>	<u>111-76-2</u>	<u>D</u>	<u>370.0</u>	<u>3900.0</u>
255	<u>Ethylene oxide</u>	<u>75-21-8</u>	<u>B1</u>	<u>1.3</u>	<u>3.2</u>
256	<u>Ethylene thiourea (ETU)</u>	<u>96-45-7</u>	<u>B2</u>	<u>5.2</u>	<u>55.0</u>
257	<u>* Ethyl chloride</u>	<u>75-00-3</u>	<u>D</u>	<u>1100.0</u>	<u>4200.0</u>
258	<u>* Ethyl ether</u>	<u>60-29-7</u>	<u>D</u>	<u>3800.0</u>	<u>3800.0</u>
259	<u>* Ethyl methacrylate</u>	<u>97-63-2</u>	<u>D</u>	<u>210.0</u>	<u>690.0</u>
260	<u>Ethyl p-nitrophenyl</u> <u>phenylphosphorothioate</u>	<u>2104-64-5</u>	<u>D</u>	<u>0.65</u>	<u>6.8</u>
261	<u>Ethylphthalyl ethyl glycolate</u>	<u>84-72-0</u>	<u>D</u>	<u>200000.0</u>	<u>1000000.0</u>
262	<u>Express</u>	<u>101200-48-0</u>	<u>D</u>	<u>520.0</u>	<u>5500.0</u>
E					
263	<u>Fenamiphos</u>	<u>22224-92-6</u>	<u>D</u>	<u>16.0</u>	<u>170.0</u>
264	<u>Fluometuron</u>	<u>2164-17-2</u>	<u>D</u>	<u>850.0</u>	<u>8900.0</u>
265	<u>Fluoranthene</u>	<u>206-44-0</u>	<u>D</u>	<u>2600.0</u>	<u>27000.0</u>
266	<u>Fluorene</u>	<u>86-73-7</u>	<u>D</u>	<u>2600.0</u>	<u>27000.0</u>
267	<u>Fluorine (soluble fluoride)</u>	<u>7782-41-4</u>	<u>D</u>	<u>3900.0</u>	<u>41000.0</u>
268	<u>Fluoridone</u>	<u>59756-60-4</u>	<u>D</u>	<u>5200.0</u>	<u>55000.0</u>
269	<u>Flurprimidol</u>	<u>56425-91-3</u>	<u>D</u>	<u>1300.0</u>	<u>14000.0</u>
270	<u>Flutolanil</u>	<u>66332-96-5</u>	<u>D</u>	<u>3900.0</u>	<u>41000.0</u>
271	<u>Fluvalinate</u>	<u>69409-94-5</u>	<u>D</u>	<u>650.0</u>	<u>6800.0</u>
272	<u>Folpet</u>	<u>133-07-3</u>	<u>B2</u>	<u>1300.0</u>	<u>5500.0</u>
273	<u>Fomesafen</u>	<u>72178-02-0</u>	<u>C</u>	<u>23.0</u>	<u>100.0</u>
274	<u>Fonofos</u>	<u>944-22-9</u>	<u>D</u>	<u>130.0</u>	<u>1400.0</u>
275	<u>Formaldehyde</u>	<u>50-00-0</u>	<u>B1</u>	<u>9800.0</u>	<u>100000.0</u>
276	<u>Formic Acid</u>	<u>64-18-6</u>	<u>D</u>	<u>130000.0</u>	<u>1000000.0</u>
277	<u>Fosetyl-al</u>	<u>39148-24-8</u>	<u>C</u>	<u>200000.0</u>	<u>1000000.0</u>
278	<u>Furan</u>	<u>110-00-9</u>	<u>D</u>	<u>2.5</u>	<u>8.5</u>
279	<u>Furazolidone</u>	<u>67-45-8</u>	<u>B2</u>	<u>1.2</u>	<u>5.0</u>
280	<u>Furfural</u>	<u>98-01-1</u>	<u>D</u>	<u>200.0</u>	<u>2000.0</u>
281	<u>Furium</u>	<u>531-82-8</u>	<u>B2</u>	<u>0.089</u>	<u>0.38</u>
282	<u>Furmecyclox</u>	<u>60568-05-0</u>	<u>B2</u>	<u>150.0</u>	<u>640.0</u>
G					
283	<u>Glufosinate-ammonium</u>	<u>77182-82-2</u>	<u>D</u>	<u>26.0</u>	<u>270.0</u>
284	<u>Glycidaldehyde</u>	<u>765-34-4</u>	<u>B2</u>	<u>26.0</u>	<u>270.0</u>
285	<u>Glyphosate</u>	<u>1071-83-6</u>	<u>D</u>	<u>6500.0</u>	<u>68000.0</u>
H					
286	<u>Haloxypop-methyl</u>	<u>69806-40-2</u>	<u>D</u>	<u>3.3</u>	<u>34.0</u>
287	<u>Harmony</u>	<u>79277-27-3</u>	<u>D</u>	<u>850.0</u>	<u>8900.0</u>
288	<u>Heptachlor</u>	<u>76-44-8</u>	<u>B2</u>	<u>0.99</u>	<u>4.2</u>
289	<u>Heptachlor epoxide</u>	<u>1024-57-3</u>	<u>B2</u>	<u>0.49</u>	<u>2.1</u>
290	<u>Hexabromobenzene</u>	<u>87-82-1</u>	<u>D</u>	<u>130.0</u>	<u>1400.0</u>
291	<u>Hexachlorobenzene</u>	<u>118-74-1</u>	<u>B2</u>	<u>2.8</u>	<u>12.0</u>
292	<u>Hexachlorobutadiene</u>	<u>87-68-3</u>	<u>C</u>	<u>13.0</u>	<u>140.0</u>
293	<u>HCH (alpha)</u>	<u>319-84-6</u>	<u>B2</u>	<u>0.71</u>	<u>3.0</u>
294	<u>HCH (beta)</u>	<u>319-85-7</u>	<u>C</u>	<u>2.5</u>	<u>11.0</u>
295	<u>HCH (gamma) Lindane</u>	<u>58-89-9</u>	<u>B2-C</u>	<u>3.4</u>	<u>15.0</u>
296	<u>HCH-technical</u>	<u>608-73-1</u>	<u>B2</u>	<u>2.5</u>	<u>11.0</u>
297	<u>Hexachlorocyclopentadiene</u>	<u>77-47-4</u>	<u>D</u>	<u>450.0</u>	<u>4600.0</u>
298	<u>Hexachlorodibenzo-p-dioxin</u> <u>mixture (HxCDD)</u>	<u>19408-74-3</u>	<u>B2</u>	<u>0.00072</u>	<u>0.0031</u>
299	<u>Hexachloroethane</u>	<u>67-72-1</u>	<u>C</u>	<u>65.0</u>	<u>680.0</u>
300	<u>Hexachlorophene</u>	<u>70-30-4</u>	<u>D</u>	<u>20.0</u>	<u>200.0</u>
301	<u>Hexahydro-1,3,5-trinitro-1,3,5-triazine</u>	<u>121-82-4</u>	<u>C</u>	<u>40.0</u>	<u>170.0</u>
302	<u>* n-Hexane</u>	<u>110-54-3</u>	<u>D</u>	<u>120.0</u>	<u>400.0</u>
303	<u>Hexazinone</u>	<u>51235-04-2</u>	<u>D</u>	<u>2200.0</u>	<u>22000.0</u>
304	<u>Hydrazine, hydrazine sulfate</u>	<u>302-01-2</u>	<u>B2</u>	<u>1.5</u>	<u>6.4</u>
305	<u>Hydrocarbons (C₁₀ to C₃₂)</u>	<u>N/A</u>	<u>N/A</u>	<u>4100.0</u>	<u>18000.0</u>

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306	Hydrogen chloride	7647-01-0	D	370.0	3900.0
307	Hydrogen cyanide	74-90-8	D	11.0	35.0
308	p-Hydroquinone	123-31-9	D	2600.0	27000.0
I					
309	Imazalil	35554-44-0	D	850.0	8900.0
310	Imazaquin	81335-37-7	D	16000.0	170000.0
311	Indenof[1,2,3-cd]pyrene	193-39-5	B2	6.1	26.0
312	Iprodione	36734-19-7	D	2600.0	27000.0
313	* Isobutanol	78-83-1	D	11000.0	42000.0
314	Isophorone	78-59-1	C	4700.0	20000.0
315	Isopropalin	33820-53-0	D	980.0	10000.0
316	Isopropyl methyl phosphonic acid	1832-54-8	D	6500.0	68000.0
317	Isoxaben	82558-50-7	C	3300.0	34000.0
K					
318	Kepone	143-50-0	B, C	0.25	1.1
L					
319	Lactofen	77501-63-4	D	130.0	1400.0
320	#Lead	7439-92-1	B2	400.0	2000.0
321	Lead (tetraethyl)	78-00-2	D	0.0065	0.068
322	Linuron	330-55-2	C	130.0	1400.0
323	Lithium	7439-93-2	D	1500.0	34000.0
324	Londax	83055-99-6	D	13000.0	140000.0
M					
325	Malathion	121-75-5	D	1300.0	14000.0
326	Maleic anhydride	108-31-6	D	6500.0	68000.0
327	Maleic hydrazide	123-33-1	D	33000.0	340000.0
328	Malononitrile	109-77-3	D	1.3	14.0
329	Mancozeb	8018-01-7	D	2000.0	20000.0
330	Maneb	12427-38-2	D	330.0	3400.0
331	Manganese and compounds	7439-96-5	D	3200.0	43000.0
332	Mepfosfolan	950-10-7	D	5.9	61.0
333	Mepiquat	24307-26-4	D	2000.0	20000.0
334	Mercuric chloride	7487-94-7	C	23.0	510.0
335	Mercury (elemental)	7439-97-6	D	6.7	180.0
336	Mercury (methyl)	22967-92-6	D	6.5	68.0
337	Merphos	150-50-5	D	2.0	20.0
338	Merphos oxide	78-48-8	D	2.0	20.0
339	Metalaxyl	57837-19-1	D	3900.0	41000.0
340	Methacrylonitrile	126-98-7	D	2.0	8.1
341	Methamidophos	10265-92-6	D	3.3	34.0
342	Methanol	67-56-1	D	33000.0	340000.0
343	Methidathion	950-37-8	C	65.0	680.0
344	Methomyl	16752-77-5	D	1600.0	17000.0
345	Methoxychlor	72-43-5	D	330.0	3400.0
346	2-Methoxyethanol	109-86-4	D	65.0	680.0
347	2-Methoxyethanol acetate	110-49-6	D	130.0	1400.0
348	2-Methoxy-5-nitroaniline	99-59-2	C	97.0	410.0
349	Methyl acetate	79-20-9	D	21000.0	88000.0
350	Methyl acrylate	96-33-3	D	69.0	230.0
351	2-Methylaniline (o-toluidine)	100-61-8	B2	19.0	79.0
352	2-Methylaniline hydrochloride	636-21-5	B2	25.0	110.0
353	Methyl chlorocarbonate	79-22-1	D	65000.0	680000.0
354	2-Methyl-4-chlorophenoxyacetic acid	94-74-6	D	33.0	340.0
355	4-(2-Methyl-4-chlorophenoxy) butyric acid	94-81-5	D	650.0	6800.0
356	2-(2-Methyl-4-chlorophenoxy) propionic acid	93-65-2	D	65.0	680.0
357	2-(2-Methyl-1,4-chlorophenoxy) propionic acid	16484-77-8	D	65.0	680.0
358	Methylcyclohexane	108-87-2	D	56000.0	590000.0
359	4,4'-Methylenebisbenzeneamine	101-77-9	D	18.0	76.0
360	4,4'-Methylene bis(2-chloroaniline)	101-14-4	B2	34.0	150.0

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361	4,4'-Methylene bis(N,N'-dimethyl)aniline	101-61-1	B2	97.0	410.0
362	Methylene bromide	74-95-3	D	650.0	6800.0
363	Methylene chloride	75-09-2	B2	77.0	180.0
364	Methyl ethyl ketone	78-93-3	D	7100.0	27000.0
365	Methyl hydrazine	60-34-4	B, C	4.0	17.0
366	Methyl isobutyl ketone	108-10-1	D	770.0	2800.0
367	* Methyl methacrylate	80-62-6	D	760.0	2800.0
368	2-Methyl-5-nitroaniline	99-55-8	C	130.0	580.0
369	Methyl parathion	298-00-0	D	16.0	170.0
370	2-Methylphenol	95-48-7	C	3300.0	34000.0
371	3-Methylphenol	108-39-4	C	3300.0	34000.0
372	4-Methylphenol	106-44-5	C	330.0	3400.0
373	Methyl styrene (mixture)	25013-15-4	D	120.0	520.0
374	* Methyl styrene (alpha)	98-83-9	D	890.0	3100.0
375	Methyl tertbutyl ether (MTBE)	1634-04-4	D	320.0	3300.0
376	Metolacolor (Dual)	51218-45-2	D	9800.0	100000.0
377	Metribuzin	21087-64-9	D	1600.0	17000.0
378	Mirex	2385-85-5	B2	2.5	11.0
379	Molinate	2212-67-1	D	130.0	1400.0
380	Molybdenum	7439-98-7	D	380.0	8500.0
381	Monochloramine	10599-90-3	D	6500.0	68000.0

N

382	Naled	300-76-5	D	130.0	1400.0
383	Naphthalene	91-20-3	D	2600.0	27000.0
384	Napropamide	15299-99-7	D	6500.0	68000.0
385	Nickel and compounds	7440-02-0	D	1500.0	34000.0
386	Nickel subsulfide	12035-72-2	A	5100.0	11000.0
387	Nitrapyrin	1929-82-4	D	98.0	1000.0
388	Nitrate	14797-55-8	D	100000.0	1000000.0
389	Nitrite	14797-65-0	D	6500.0	68000.0
390	2-Nitroaniline	88-74-4	D	3.9	41.0
391	Nitrobenzene	98-95-3	D	18.0	94.0
392	Nitrofurantoin	67-20-9	D	4600.0	48000.0
393	Nitrofurazone	59-87-0	B2	3.0	13.0
394	Nitroguanidine	556-88-7	D	6500.0	68000.0
395	N-Nitrosodi-n-butylamine	924-16-3	B2	0.22	0.55
396	N-Nitrosodiethanolamine	1116-54-7	B2	1.6	6.8
397	N-Nitrosodiethylamine	55-18-5	B2	0.03	0.13
398	N-Nitrosodimethylamine	62-75-9	B2	0.087	0.37
399	N-Nitrosodiphenylamine	86-30-6	B2	910.0	3900.0
400	N-Nitroso di-n-propylamine	621-64-7	B2	0.63	2.7
401	N-Nitroso-N-methylethylamine	10595-95-6	B2	0.20	0.87
402	N-Nitrosopyrrolidine	930-55-2	B2	2.1	9.1
403	m-Nitrotoluene	99-08-1	D	650.0	6800.0
404	p-Nitrotoluene	99-99-0	D	650.0	6800.0
405	Norflurazon	27314-13-2	D	2600.0	27000.0
406	NuStar	85509-19-9	D	46.0	480.0

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407	Octabromodiphenyl ether	32536-52-0	D	200.0	2000.0
408	Octahydro-1357-tetranitro-1357- tetrazocine	2691-41-0	D	3300.0	34000.0
409	Octamethylpyrophosphoramidate	152-16-9	D	130.0	1400.0
410	Oryzalin	19044-88-3	C	3300.0	34000.0
411	Oxadiazon	19666-30-9	D	330.0	3400.0
412	Oxamyl	23135-22-0	E	1600.0	17000.0
413	Oxyfluorfen	42874-03-3	D	200.0	2000.0

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414	Paclobutrazol	76738-62-0	D	850.0	8900.0
415	Paraquat	4685-14-7	C	290.0	3100.0
416	Parathion	56-38-2	C	390.0	4100.0
417	Pebulate	1114-71-2	D	3300.0	34000.0
418	Pendimethalin	40487-42-1	D	2600.0	27000.0

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419	Pentabromo-6-chloro cyclohexane	87-84-3	C	190.0	830.0
420	Pentabromodiphenyl ether	32534-81-9	D	130.0	1400.0
421	Pentachlorobenzene	608-93-5	D	52.0	550.0
422	Pentachloronitrobenzene	82-68-8	C	17.0	73.0
423	Pentachlorophenol	87-86-5	B2	25.0	79.0
424	Permethrin	52645-53-1	D	3300.0	34000.0
425	Phenmedipham	13684-63-4	D	16000.0	170000.0
426	Phenol	108-95-2	D	39000.0	410000.0
427	m-Phenylenediamine	108-45-2	D	390.0	4100.0
428	p-Phenylenediamine	106-50-3	D	12000.0	130000.0
429	Phenylmercuric acetate	62-38-4	D	5.2	55.0
430	2-Phenylphenol	90-43-7	C	2300.0	9800.0
431	Phorate	298-02-2	E	13.0	140.0
432	Phosmet	732-11-6	D	1300.0	14000.0
433	Phosphine	7803-51-2	D	20.0	200.0
434	Phosphorus, white	7723-14-0	D	1.5	34.0
435	Phthalic anhydride	85-44-9	D	130000.0	1000000.0
436	Picloram	1918-02-1	D	4600.0	48000.0
437	Pirimiphos-methyl	23505-41-1	D	650.0	6800.0
438	Polybrominated biphenyls (PBBs)	N/A	B2	0.46	2.1
439	Polychlorinated biphenyls (PCBs)	1336-36-3	B2	2.5	13.0
440	Potassium cyanide	151-50-8	D	3300.0	34000.0
441	Potassium silver cyanide	506-61-6	D	13000.0	140000.0
442	Prochloraz	67747-09-5	C	30.0	130.0
443	Profluralin	26399-36-0	D	390.0	4100.0
444	Prometon	1610-18-0	D	280.0	10000.0
445	Prometryn	7287-19-6	D	260.0	2700.0
446	Pronamide	23950-58-5	C	4900.0	51000.0
447	Propachlor	1918-16-7	D	850.0	8900.0
448	Propanil	709-98-8	D	330.0	3400.0
449	Propargite	2312-35-8	D	1300.0	14000.0
450	Propargyl alcohol	107-19-7	D	130.0	1400.0
451	Propazine	139-40-2	C	1300.0	14000.0
452	Propham	122-42-9	D	1300.0	14000.0
453	Propiconazole	60207-90-1	D	850.0	8900.0
454	Propylene glycol	57-55-6	D	1000000.0	1000000.0
455	Propylene glycol, monoethyl ether	111-35-3	D	46000.0	480000.0
456	Propylene glycol, monomethyl ether	107-98-2	D	46000.0	480000.0
457	Propylene oxide	75-56-9	B2	19.0	79.0
458	Pursuit	81335-77-5	D	16000.0	170000.0
459	Pydrin	51630-58-1	D	1600.0	17000.0
460	Pyrene	129-00-0	D	2000.0	20000.0
461	Pyridine	110-86-1	D	65.0	680.0
Q					
462	Quinalphos	13593-03-8	D	33.0	340.0
463	Quinoline	91-22-5	C	0.37	1.6
R					
464	RDX (Cyclonite)	121-82-4	C	40.0	170.0
465	Resmethrin	10453-86-8	D	2000.0	20000.0
466	Ronnel	299-84-3	D	3300.0	34000.0
467	Rotenone	83-79-4	D	260.0	2700.0
S					
468	Savey	78578-05-0	D	1600.0	17000.0
469	Selenious Acid	7783-00-8	D	330.0	3400.0
470	Selenium	7782-49-2	D	380.0	8500.0
471	Selenourea	630-10-4	D	330.0	3400.0
472	Sethoxydim	74051-80-2	D	5900.0	61000.0
473	Silver and compounds	7440-22-4	D	380.0	8500.0
474	Silver cyanide	506-64-9	D	6500.0	68000.0
475	Simazine	122-34-9	C	37.0	160.0
476	Sodium azide	26628-22-8	D	260.0	2700.0
477	Sodium cyanide	143-33-9	D	2600.0	27000.0

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478	<u>Sodium diethyldithiocarbamate</u>	<u>148-18-5</u>	C	<u>16.0</u>	<u>71.0</u>
479	<u>Sodium fluoroacetate</u>	<u>62-74-8</u>	D	<u>1.3</u>	<u>14.0</u>
480	<u>Sodium metavanadate</u>	<u>13718-26-8</u>	D	<u>65.0</u>	<u>680.0</u>
481	<u>Strontium, stable</u>	<u>7440-24-6</u>	D	<u>46000.0</u>	<u>1000000.0</u>
482	<u>Strychnine</u>	<u>57-24-9</u>	D	<u>20.0</u>	<u>200.0</u>
483	<u>* Styrene</u>	<u>100-42-5</u>	C	<u>3300.0</u>	<u>3300.0</u>
484	<u>Systhane</u>	<u>88671-89-0</u>	D	<u>1600.0</u>	<u>17000.0</u>

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485	<u>2,3,7,8-TCDD (dioxin)</u>	<u>1746-01-6</u>	B2	<u>0.000038</u>	<u>0.00024</u>
486	<u>Tebuthiuron</u>	<u>34014-18-1</u>	D	<u>4600.0</u>	<u>48000.0</u>
487	<u>Temephos</u>	<u>3383-96-8</u>	D	<u>1300.0</u>	<u>14000.0</u>
488	<u>Terbacil</u>	<u>5902-51-2</u>	E	<u>850.0</u>	<u>8900.0</u>
489	<u>Terbufos</u>	<u>13071-79-9</u>	D	<u>1.6</u>	<u>17.0</u>
490	<u>Terbutryn</u>	<u>886-50-0</u>	D	<u>65.0</u>	<u>680.0</u>
491	<u>1,2,4,5-Tetrachlorobenzene</u>	<u>95-94-3</u>	D	<u>20.0</u>	<u>200.0</u>
492	<u>1,1,1,2-Tetrachloroethane</u>	<u>630-20-6</u>	C	<u>23.0</u>	<u>54.0</u>
493	<u>1,1,2,2-Tetrachloroethane</u>	<u>79-34-5</u>	C	<u>4.4</u>	<u>11.0</u>
494	<u>Tetrachloroethylene (PCE)</u>	<u>127-18-4</u>	B2	<u>53.0</u>	<u>170.0</u>
495	<u>2,3,4,6-Tetrachlorophenol</u>	<u>58-90-2</u>	D	<u>2000.0</u>	<u>20000.0</u>
496	<u>p,a,a-Tetrachlorotoluene</u>	<u>5216-25-1</u>	B2	<u>0.22</u>	<u>0.95</u>
497	<u>Tetrachlorovinphos</u>	<u>961-11-5</u>	C	<u>190.0</u>	<u>790.0</u>
498	<u>Tetraethyldithiopyrophosphate</u>	<u>3689-24-5</u>	D	<u>33.0</u>	<u>340.0</u>
499	<u>Thallic oxide</u>	<u>1314-32-5</u>	D	<u>5.4</u>	<u>120.0</u>
500	<u>Thallium acetate</u>	<u>563-68-8</u>	D	<u>6.9</u>	<u>150.0</u>
501	<u>Thallium carbonate</u>	<u>6533-73-9</u>	D	<u>6.1</u>	<u>140.0</u>
502	<u>Thallium chloride</u>	<u>7791-12-0</u>	D	<u>6.1</u>	<u>140.0</u>
503	<u>Thallium nitrate</u>	<u>10102-45-1</u>	D	<u>6.9</u>	<u>150.0</u>
504	<u>Thallium selenite</u>	<u>12039-52-0</u>	D	<u>6.9</u>	<u>150.0</u>
505	<u>Thallium sulfate</u>	<u>7446-18-6</u>	D	<u>6.1</u>	<u>140.0</u>
506	<u>Thiobencarb</u>	<u>28249-77-6</u>	D	<u>650.0</u>	<u>6800.0</u>
507	<u>2-(Thiocyanomethylthio)- benzothiazole</u>	<u>3689-24-5</u>	D	<u>2000.0</u>	<u>20000.0</u>
508	<u>Thiofanox</u>	<u>39196-18-4</u>	D	<u>20.0</u>	<u>200.0</u>
509	<u>Thiophanate-methyl</u>	<u>23564-05-8</u>	D	<u>5200.0</u>	<u>55000.0</u>
510	<u>Thiram</u>	<u>137-26-8</u>	D	<u>330.0</u>	<u>3400.0</u>
511	<u>Tin and compounds</u>	<u>7440-31-5</u>	D	<u>46000.0</u>	<u>1000000.0</u>
512	<u>* Toluene</u>	<u>108-88-3</u>	D	<u>790.0</u>	<u>2700.0</u>
513	<u>Toluene-2,4-diamine</u>	<u>95-80-7</u>	B2	<u>1.4</u>	<u>6.0</u>
514	<u>Toluene-2,5-diamine</u>	<u>95-70-5</u>	D	<u>39000.0</u>	<u>410000.0</u>
515	<u>Toluene-2,6-diamine</u>	<u>823-40-5</u>	C	<u>13000.0</u>	<u>140000.0</u>
516	<u>p-Toluidine</u>	<u>106-49-0</u>	C	<u>23.0</u>	<u>100.0</u>
517	<u>Toxaphene</u>	<u>8001-35-2</u>	B2	<u>4.0</u>	<u>17.0</u>
518	<u>Tralomethrin</u>	<u>66841-25-6</u>	D	<u>490.0</u>	<u>5100.0</u>
519	<u>Triallate</u>	<u>2303-17-5</u>	D	<u>850.0</u>	<u>8900.0</u>
520	<u>Triasulfuron</u>	<u>82097-50-5</u>	D	<u>650.0</u>	<u>6800.0</u>
521	<u>1,2,4-Tribromobenzene</u>	<u>615-54-3</u>	D	<u>330.0</u>	<u>3400.0</u>
522	<u>Tributyltin oxide (TBTO)</u>	<u>56-35-9</u>	D	<u>2.0</u>	<u>20.0</u>
523	<u>2,4,6-Trichloroaniline</u>	<u>634-93-5</u>	C	<u>130.0</u>	<u>560.0</u>
524	<u>2,4,6-Trichloroaniline hydrochloride</u>	<u>33663-50-2</u>	C	<u>150.0</u>	<u>660.0</u>
525	<u>* 1,2,4-Trichlorobenzene</u>	<u>120-82-1</u>	D	<u>570.0</u>	<u>4700.0</u>
526	<u>* 1,1,1-Trichloroethane</u>	<u>71-55-6</u>	D	<u>1200.0</u>	<u>4800.0</u>
527	<u>1,1,2-Trichloroethane</u>	<u>79-00-5</u>	C	<u>6.5</u>	<u>15.0</u>
528	<u>Trichloroethylene (TCE)</u>	<u>79-01-6</u>	B2	<u>27.0</u>	<u>70.0</u>
529	<u>Trichlorofluoromethane</u>	<u>75-69-4</u>	D	<u>380.0</u>	<u>1300.0</u>
530	<u>2,4,5-Trichlorophenol</u>	<u>95-95-4</u>	D	<u>6500.0</u>	<u>68000.0</u>
531	<u>2,4,6-Trichlorophenol</u>	<u>88-06-2</u>	B2	<u>400.0</u>	<u>1700.0</u>
532	<u>2,4,5-Trichlorophenoxyacetic Acid</u>	<u>93-76-5</u>	D	<u>650.0</u>	<u>6800.0</u>
533	<u>2-(2,4,5-Trichlorophenoxy) propionic acid</u>	<u>93-72-1</u>	D	<u>520.0</u>	<u>5500.0</u>
534	<u>1,1,2-Trichloropropane</u>	<u>598-77-6</u>	D	<u>15.0</u>	<u>50.0</u>
535	<u>1,2,3-Trichloropropane</u>	<u>96-18-4</u>	B2	<u>0.014</u>	<u>0.03</u>
536	<u>1,2,3-Trichloropropene</u>	<u>96-19-5</u>	D	<u>11.0</u>	<u>38.0</u>
537	<u>* 1,1,2-Trichloro-1,2,2-trifluoroethane</u>	<u>76-13-1</u>	D	<u>10000.0</u>	<u>10000.0</u>
538	<u>Tridiphane</u>	<u>58138-08-2</u>	D	<u>200.0</u>	<u>2000.0</u>
539	<u>Triethylamine</u>	<u>121-44-8</u>	D	<u>23.0</u>	<u>84.0</u>
540	<u>Trifluralin</u>	<u>1582-09-8</u>	C	<u>490.0</u>	<u>2500.0</u>

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<u>541</u> <u>Trimethyl phosphate</u>	<u>512-56-1</u>	<u>B2</u>	<u>120.0</u>	<u>520.0</u>
<u>542</u> <u>1,3,5-Trinitrobenzene</u>	<u>99-35-4</u>	<u>D</u>	<u>3.3</u>	<u>34.0</u>
<u>543</u> <u>Trinitrophenylmethylnitramine</u>	<u>479-45-8</u>	<u>D</u>	<u>650.0</u>	<u>6800.0</u>
<u>544</u> <u>2,4,6-Trinitrotoluene</u>	<u>118-96-7</u>	<u>C</u>	<u>33.0</u>	<u>340.0</u>
<u>V</u>				
<u>545</u> <u>Vanadium</u>	<u>7440-62-2</u>	<u>D</u>	<u>540.0</u>	<u>12000.0</u>
<u>546</u> <u>Vanadium pentoxide</u>	<u>1314-62-1</u>	<u>D</u>	<u>690.0</u>	<u>15000.0</u>
<u>547</u> <u>Vanadium sulfate</u>	<u>13701-70-7</u>	<u>D</u>	<u>1500.0</u>	<u>34000.0</u>
<u>548</u> <u>Vernam</u>	<u>1929-77-7</u>	<u>D</u>	<u>65.0</u>	<u>680.0</u>
<u>549</u> <u>Vinclozolin</u>	<u>50471-44-8</u>	<u>D</u>	<u>1600.0</u>	<u>17000.0</u>
<u>550</u> <u>Vinyl acetate</u>	<u>108-05-4</u>	<u>D</u>	<u>780.0</u>	<u>2600.0</u>
<u>551</u> <u>Vinyl bromide</u>	<u>593-60-2</u>	<u>B2</u>	<u>1.9</u>	<u>4.1</u>
<u>552</u> <u>Vinyl chloride</u>	<u>75-01-4</u>	<u>A</u>	<u>0.016</u>	<u>0.035</u>
<u>W</u>				
<u>553</u> <u>Warfarin</u>	<u>81-81-2</u>	<u>D</u>	<u>20.0</u>	<u>200.0</u>
<u>X</u>				
<u>554</u> <u>* Xylene (mixed)</u>	<u>1330-20-7</u>	<u>D</u>	<u>2800.0</u>	<u>2800.0</u>
<u>Z</u>				
<u>555</u> <u>Zinc</u>	<u>7440-66-6</u>	<u>D</u>	<u>23000.0</u>	<u>510000.0</u>
<u>556</u> <u>Zinc phosphide</u>	<u>1314-84-7</u>	<u>D</u>	<u>23.0</u>	<u>510.0</u>
<u>557</u> <u>Zinc cyanide</u>	<u>557-21-1</u>	<u>D</u>	<u>3300.0</u>	<u>34000.0</u>
<u>558</u> <u>Zineb</u>	<u>12122-67-7</u>	<u>D</u>	<u>3300.0</u>	<u>34000.0</u>

* = 1% free-phase analysis

= Based on IEUBK Model

~ = Based on natural background

N/A = Not Applicable

CARCINOGENICITY CLASSIFICATIONS:

A=Known human carcinogen

B1=Probable human carcinogen, with limited data indicating human carcinogenicity.

B2=Probable human carcinogen, with inadequate or no evidence of carcinogenicity in humans.

Sufficient evidence for carcinogenicity in laboratory animals.

C=Possible human carcinogen

D=Not classifiable as to human carcinogenicity

E=Evidence of noncarcinogenicity in humans

When recorded, mail to:

APPENDIX B

NOTICE OF VOLUNTARY ENVIRONMENTAL MITIGATION

USE RESTRICTION BY OWNER(S)

Pursuant to A.R.S. §49-152(B), the owner(s) _____ of the following
described property: (Please Print)

(insert legal description of entire parcel)

has (have) remediated a portion of the above-described property, which remediated portion is described as follows:

(insert legal description of remediated portion, the source of the release, and the remaining contaminants)

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The date when the remediation was completed is: _____

The undersigned owner voluntarily agrees to limit and restrict the use of the remediated portion of the property to non-residential uses, as defined in A.R.S. §49-151(A).

Approved: _____

Signature of owner(s)

(ADEQ official) Signature of owner(s)

STATE OF ARIZONA

STATE OF ARIZONA

County of _____

County of _____

This instrument was acknowledged before me this _____ day of _____, _____ This instrument was acknowledged before me this _____ day of _____, _____

by _____ by _____

Notary Public

Notary Public

My commission expires: _____ My commission expires: _____

Please make no marks below this line

APPENDIX B

When recorded, mail to:

NOTICE OF VOLUNTARY ENVIRONMENTAL MITIGATION

USE RESTRICTION BY OWNER(S)

Pursuant to A.R.S. §49-152(B), the owner or owners _____ of the following described property:

(Please Print)

(insert legal description of entire parcel)

has (have) remediated a portion of the above-described property, which remediated portion is described as follows:

(insert legal description of remediated portion, the source of the release, and the remaining contaminants)

The date when the remediation was completed is: _____

The undersigned owner voluntarily agrees to limit and restrict the use of the remediated portion of the property to non-residential uses, as defined in A.R.S. §49-151(A).

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Signature of owner

STATE OF ARIZONA

County of _____

On this _____ day of _____, 19____, before me personally appeared _____ (name of signer), whose identity was proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to this document, and who acknowledged that he/she signed the above document.

Notary Public

(Notary Seal)

My commission expires: _____

(if 2nd owner's signature is required)

Signature of owner

STATE OF ARIZONA

County of _____

On this _____ day of _____, 19____, before me personally appeared _____ (name of signer), whose identity was proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to this document, and who acknowledged that he/she signed the above document.

Notary Public

(Notary Seal)

My commission expires: _____

Approved: _____
(ADEQ official)

STATE OF ARIZONA

County of _____

On this _____ day of _____, 19____, before me personally appeared _____ (name of signer), whose identity was proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to this document, and who acknowledged that he/she signed the above document.

Notary Public

(Notary Seal)

My commission expires: _____

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When recorded, mail to:

APPENDIX C

**CANCELLATION OF VOLUNTARY ENVIRONMENTAL MITIGATION
USE RESTRICTION BY OWNER(S)**

Pursuant to A.R.S. § 49-152(B), the owner(s) _____
of the following described property: _____ (Please Print)

(insert legal description of entire parcel)

recorded a Notice of Voluntary Mitigation Use Restriction By Owner(s) in the Office of the County Recorder of _____
County, Arizona on the _____ day of _____, _____ in Document/Docket _____ at Page _____, affecting the following
portion of the above-described property:

(insert legal description of remediated portion)

The undersigned owner(s) has (have) remediated the above-described portion of the property pursuant to the levels prescribed in A.R.S.
§49-152(C). Accordingly the above-described property may now be used for any lawful purpose. The date when the remediation was
completed is: _____

Signature of owner(s)

Signature of owner(s)

Pursuant to A.R.S. §49-152(C), the undersigned hereby cancel(s) the above-described notice and declare(s) said notice to be of no fur-
ther force and effect as of this _____ day of _____,

(ADEQ official)

STATE OF ARIZONA

STATE OF ARIZONA

County of _____

County of _____

This instrument was acknowledged before me this

This instrument was acknowledged before me this

_____ day of _____,

_____ day of _____,

by _____

by _____

Notary Public

Notary Public

My commission expires: _____

My commission expires: _____

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APPENDIX C

When recorded, mail to:

CANCELLATION OF VOLUNTARY ENVIRONMENTAL MITIGATION
USE RESTRICTION BY OWNER(S)

Pursuant to A.R.S. §49-152(B), the owner or owners _____

of the following described property:

(Please Print)

(insert legal description of entire parcel)

recorded a Notice of Voluntary Mitigation Use Restriction By Owner or Owners in the Office of the County Recorder of
County, Arizona on the _____ day of _____, in Document/Docket _____ at Page _____, affect-
ing the following portion of the above-described property:

(insert legal description of remediated portion)

Pursuant to A.R.S. §49-152(C), the undersigned hereby cancel or cancels the above-described notice and declare or declares said notice
to be of no further force and effect as of this _____ day of _____.

Signature of owner

STATE OF ARIZONA

County of _____

On this _____ day of _____, 19____, before me personally appeared _____ (name of
signer), whose identity was proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to this
document, and who acknowledged that he/she signed the above document.

Notary Public

(Notary Seal)

My commission expires: _____

(ADEQ official)

STATE OF ARIZONA

County of _____

Arizona Administrative Register

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On this _____ day of _____, 19____, before me personally appeared _____ (name of signer), whose identity was proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to this document, and who acknowledged that he/she signed the above document.

Notary Public

(Notary Seal)

My commission expires: _____

Please make no marks below this line

APPENDIX D

The seller's disclosure required by A.R.S. § 33-434.01 shall be sufficient if it is in substantially the following form of part V of the Arizona Department of Real Estate's "Seller's Property Disclosure Statement":

"Has any portion of the property been subject to soil remediation AND not cleaned up to residential use standards adopted by the Arizona Department of Environmental Quality?"

(Answers: Yes, No, Unknown)

NOTICE OF FINAL RULEMAKING

✓ TITLE 18. ENVIRONMENTAL QUALITY

**CHAPTER 8. DEPARTMENT OF ENVIRONMENTAL QUALITY
WASTE MANAGEMENT**

PREAMBLE

1. **Sections Affected:**
R18-8-101
- Rulemaking Action:**
New Section
2. **The specific authority for the rulemaking, including both the authorizing statute (general) and the statutes the rules are implementing (specific):**
Authorizing statute: A.R.S. §§ 49-104(B)(4), 49-104(B)(16), 49-152, and Laws 1995, Ch.232, § 5.
Implementing statute: A.R.S. §§ 49-151, 49-152, 49-282.06.
3. **The effective date of the rules:**
December 4, 1997.
4. **A citation to all published notices relating to the proceeding:**
Notice of Emergency Rulemaking: 2 A.A.R. 1484, April 19, 1996
Notice of Docket Opening: 2 A.A.R. 3218, June 21, 1996
Notice of Proposed Rulemaking: 3 A.A.R. 662, February 28, 1997
Notice of Public Information: 3 A.A.R. 1224, May 2, 1997
5. **The name and address of agency personnel with whom persons may communicate regarding the rule:**
Name: Katheryn A. Cross
Address: 3033 North Central Avenue #824
Phoenix, Arizona 85012-2809
Telephone: (602) 207-2222 or (800) 234-5677, ext. 2222

(Arizona only)

Fax: (602) 207-2251

6. An explanation of the rule, including the agency's reasons for initiating the rule:

This Notice of Final Rulemaking contains a reference that in any instance where soil remediation is done under 18 A.A.C. 8, it is to be conducted in accordance with A.A.C. R18-7-201 through R18-7-209. For further information, please see explanatory material for this rulemaking under 18 A.A.C. 7 in this issue of the *Register*.

The purpose of this rule is to establish Department-wide risk-based standards applicable to soil remediation activities. Current A.R.S. Title 49 statutes and rules require contaminated soil to be cleaned up (or remediated). This rule answers the question of "how clean is clean" across all departmental soil cleanup programs. Generally speaking, soil which meets the remediation standards described in the rule is "clean enough." The Soil Remediation Standards Rule replaces a practice of establishing cleanup standards on a program-by-program, and often site-by-site, basis.

This rule is based on the idea of "risk-based remediation" which means that cleanup levels relate to the risk to human health and the environment posed by contaminated soil. Risk-based remediation should result in greater cost effectiveness by better matching expenditures to the contaminated site posing the greatest amount of risk. This rule only applies to contaminated soil, and it will not apply retroactively.

A.R.S. § 49-152(A) sets forth a 2 step process to be used in promulgating soil remediation standards: interim and final standards. Today's rule, which contains final standards, completes that 2nd step.

7. A showing of good cause why the rule is necessary to promote a statewide interest if the rule will diminish a previous grant of authority of a political subdivision of this state:

Not applicable.

8. The summary of the economic, small business and consumer impact:

Please see the summary of the economic, small business and consumer impact for this rulemaking found under 18 A.A.C. 7 of this issue of the *Register*.

9. A description of the changes between the proposed rules, including supplemental notices, and final rules (if applicable):

As proposed, this rule required that in any instance where soil remediation is performed under 18 A.A.C. 8, it shall be conducted in accordance with A.A.C. R18-7-201 through R18-7-208. Based upon comments received on 18 A.A.C. 7, the Department added a section to that rule, with the result that 18 A.A.C. 8 reference should now require that where soil remediation is performed under 18 A.A.C. 8, it shall be conducted in accordance with A.A.C. R18-7-201 through R18-7-209.

10. A summary of the principal comments and the agency response to them:

There were no comments received on this Chapter 8 rulemaking.

11. Any other matters prescribed by statute that are applicable to the specific agency or to any specific rule or class of rules:

Not applicable.

12. Incorporations by reference and their location in the rules:

None

13. Was this rule previous adopted as an emergency rule? If yes, please indicate the Register citation:

2 A.A.R. 1484, April 19, 1996

14. The full text of the rules follows:

TITLE 18. ENVIRONMENTAL QUALITY

CHAPTER 8. DEPARTMENT OF ENVIRONMENTAL QUALITY

WASTE MANAGEMENT

ARTICLE 1. REMEDIAL ACTION REQUIREMENTS

Section
R18-8-101. Remedial Action Requirements: Level and Extent of Cleanup

ARTICLE 1. REMEDIAL ACTION REQUIREMENTS

R18-8-101. Remedial Action Requirements: Level and Extent of Cleanup

- A. This Article is applicable to Chapter 8 of this Title.
- B. In any instance where soil remediation is done under this Chapter, it shall be conducted in accordance with R18-7-201 through R18-7-209.